THE

Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL.

Edited by JOSEPH HUGHES.

'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

VOL. VII. NO. 5. JULY, 1887. PRICE, 6D. POST FREE, 7½D.

Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

THE EYE.

Mechanism of Vision.

IF a beam of sunlight is allowed to pass through a hole in the shutter of a dark room, the rays of light passing through the opening, will form an inverted image of the external objects on the opposite wall of the room.

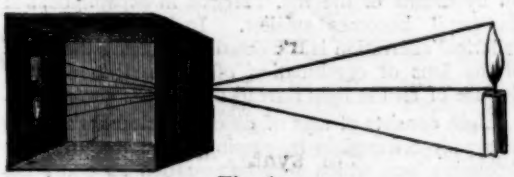


Fig. 69.
Inverted image formed by rays passing through a small opening into a dark room (Camera Obscura).

Unless the hole is very small the image is blurred owing to overlapping of rays of light; while if the hole is small, the image is clear but dim, owing to the loss of light. If a convex lens be interposed in the path of the rays, the hole may be enlarged, and the various rays are brought to a focus so as to produce a clear and bright image. This principle is utilised in the photographic camera, in which the image is focussed on a plate sensitive for light, which has been substituted for one side of the box. The interior of the box is blackened to prevent reflection from the walls. The necessity for placing the camera at a considerable distance in order that divergent rays of light may be thrown on the sensitive plate, is obviated by placing a lens in front of the camera, which brings the rays of light to a focus on the plate. The eyeball is just such a camera, the cornea forming a refracting surface tending to render the rays of light convergent, while the retina acts as a sensitive plate, and the choroid prevents reflection of superfluous rays of light. In the camera the object is brought into focus by altering the distance between the lens and the sensitive plate. This would be inconvenient in the case of the eye, and the focussing in it is performed by the interposition of a lens, the curvature of which can be varied with circumstances.

Accommodation.

In the normal eye at rest parallel rays of light (from a distant object) are focussed on to the retina, while divergent rays would tend to be focussed behind it.

The manner in which parallel rays of light are brought to a focus F is shown in fig. 70.

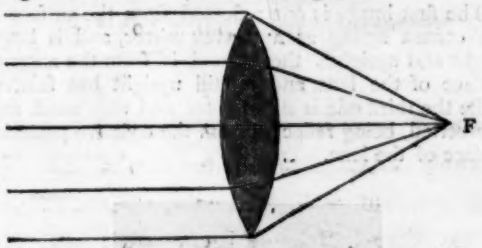


Fig. 70.
The principal focus of a Convex Lens.

An increase in convexity of the lens would allow rays of light to be brought to a nearer focus. In the eye there is a special mechanism for increasing the convexity of the lens, and thus *accommodating* its condition to near vision. Far-sight implies that the lens is at rest; near sight implies increased convexity of the lens.

The lens is attached tightly by the suspensory ligament to the ciliary processes, its anterior surface especially being somewhat flattened by the tension of the ligament. During accommodation, the ciliary muscle contracts, pulls the ciliary processes forwards and inwards, thus relaxing the suspensory ligament, when the elasticity of the lens at once causes it to become more convex (fig. 71).

Fig. 71.
Diagram to illustrate Mechanism of Accommodation.

BRITISH MUSEUM

The *near point*, *i.e.*, the smallest distance at which an object can be distinguished, is in a child 3 inches, in an adult 4 to 5 ins. The *far point* is for all practical purposes infinite. For any distance less than 20 ft. some degree of accommodation is required.

The changes in the lens during accommodation may be demonstrated by the following experiment. The observer *b* stands in a dark room in front of *a*, who holds a candle in his hand in the position *c*. The observer on looking carefully will be able to see in the eye of *a* three images of the candle flame.

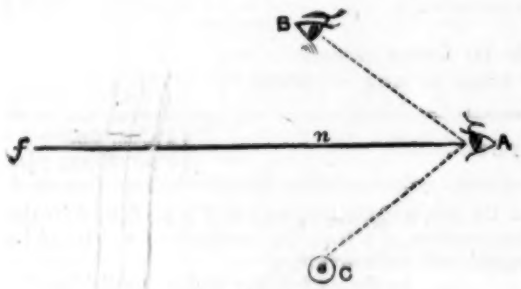


Fig. 72.

Helmholtz's Experiment. A, eye observed. B, eye of observer. C, section of candle. *n*, a near point of sight. *f*, a distant point.

The first image is one reflected from the surface of the cornea acting as a convex mirror, and is large, bright and upright; the second is from the anterior surface of the lens, and is still upright but fainter; while the third one is still fainter and very small, and is inverted, being reflected from the concave posterior surface of the lens.

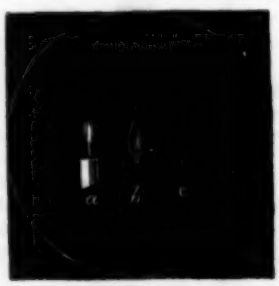


Fig. 73.

If now the person experimented on be asked to transfer his point of vision to some near object, as at *n*, the observer will see that the images *a* and *c* do not change, but *b* changes its position and becomes smaller. This is the image reflected from the anterior surface of the lens, and the fact that the image becomes smaller shows that the anterior surface becomes more convex.

Defects of Vision

In old people the lens loses its elasticity, and accommodation for near objects (under 20 inches) cannot therefore be accomplished. This condition is known as *presbyopia*. Convex glasses remedy the defect, which is only present for reading and other purposes requiring near vision.

In some young people a condition known as *hypermetropia* or *long-sight* occurs. The eyeball is too short, and consequently even for distant vision a strain is produced on the ciliary muscles to ensure the necessarily increased convexity of the lens which is required to bring rays of light to a focus on the retina.

In *short-sight* or *myopia*, the eye-ball is too long, and so rays of light from a distance are brought to a focus in front of the retina. The only way to obtain distinct vision in this condition is to render the rays very divergent by holding the object near the eyes. The use of concave glasses renders distant vision possible by changing parallel into divergent rays of light.

Another defect of vision which occasionally produces defective or slow vision, is known as *astigmatism*. In this condition the curvature of the cornea is usually at fault, being unequal in different directions. The consequence is that rays of light entering in one meridian are brought to a focus sooner than those entering at another, and the image is blurred in certain directions.

In common with other optical instruments the eye suffers from spherical and chromatic aberration. In an ordinary lens, with surfaces which form part of spheres, all the rays are not accurately focussed to the same point, the circumferential rays being brought to a focus sooner than the central. This is called *spherical aberration*, and is usually corrected by shutting off the circumferential rays in which the error is greatest by means of a diaphragm or partition. In the eye the diaphragm is provided in the shape of the iris. When the lens becomes more convex during accommodation for near objects, the spherical aberration will be greater, and more light will have to be cut off by means of the iris. Hence in accommodation the pupil becomes smaller. In microscopes the spherical aberration is corrected by altering the curve of the lens or combination of lenses, thus allowing the use of all the light instead of only the central part.

Light consists of rays of different colours which are unequally refrangible in passing through a prism (or through a lens, which may be regarded as consisting of two prisms apposed to each other). The effect of a prism in dispersing a ray of white sunlight into its coloured constituents is shown in fig. 74.

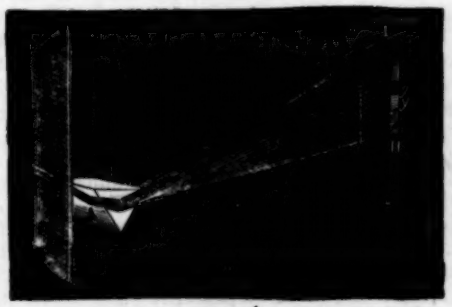


Fig. 74.

Effect of Prism on a Ray of Sunlight.

By means of a convex lens violet rays will be brought to a focus nearer than the red, and the green between the two. This defect in lenses is called *chromatic aberration*.

In the microscope, the error is overcome by the use of special combinations of lenses of different

materials having different degrees of refrangibility; such as a double convex lens of crown glass with a concave lens of flint glass. In the human eye there is slight chromatic aberration, but much of it is removed by the different refrangibility of the various media through which rays of light have to pass before they impinge on the retina. Historically the hint for correction of chromatism by combination of lenses was taken from the structure of the eye by Euler, and afterwards successfully effected by Dollond. The absence of coloured edges of strongly illuminated objects shows the practical absence of chromatism from the eye; though by refined methods, and with the extreme colours, red and violet, it has been shown that the eye is not perfectly achromatic.

Colour Vision.

There is difference of opinion on nearly every point connected with colour vision. The usually accepted view as stated first by Young, is that the three primary colour sensations correspond to what we call red, green, and violet, and that there are three kinds of rods and cones which severally co-vibrate with these three primary colours. When two kinds vibrate intermediate colours are perceived; and when all vibrate together, white light is perceived.

Apart from the lack of nice discrimination of colours, which is the result of defective culture, some persons have no perception of colours as such, and are colour-blind. It is usually the lower end of the spectrum which is defective, yellow and blue being perceived, but not red and green. We must suppose that there is some corresponding defect in the structure of the retina, the rods and cones corresponding to red and green being defective.

After-Images.

The sensation of vision lasts much longer than the stimulus, and when the latter is very strong may be so prolonged, as to be spoken of as an after-image. Thus, it the sun is looked at the image of it will be present for a long time after. This is an instance of a *positive* after-image. Occasionally a *negative* after-image is produced. Thus, if one looks stedfastly at a black patch on a white ground, and then turns the eye to a grey surface, a white patch will be seen for some little time. This is explained by exhaustion of the retinal elements. The whole of the retina has become exhausted except at the patch; here the retina is therefore for a while most sensitive, and hence the white negative image.

By using different colours the complementary colours may be thus negatively brought out. Thus red produces a green-blue; orange produces a blue; green a pink; yellow a blue negative image.

Movements of the Pupil.

In speaking of spherical aberration it has already been said that the pupil contracts during accommodation for near vision. The one movement is associated with the other. The iris has not the power of contracting voluntarily; it is only during accommodation or from reflex influences that the third cranial nerve which controls the sphincteric portion of the iris is stimulated, and consequently contraction of the pupil is produced.

When a bright light falls on the retina, the pupil contracts. This is a reflex act, the retina and optic nerve being the afferent channel, the 3rd nerve the efferent nerve, and the centre, that part of the brain known as the corpora quadrigemina.

When one adjusts the eye for distant objects, the pupil dilates, or in comparative darkness when the stimulus of light to the optic nerve is removed. Certain drugs like Atropia also cause dilatation of the pupil.

If the sympathetic nerve in the neck be divided, the pupil contracts (the 3rd nerve being intact), while if the divided sympathetic be stimulated well-marked dilatation of the pupil occurs. Thus stimulation of the sympathetic nerve dilates the pupils (by causing contraction of the radial fibres of the iris) while stimulation of the sympathetic contracts blood-vessels.

(To be continued.)

—o—

Mental Arithmetic, its Principles and Practice.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' 'Tips in Algebra,' 'Easy Steps in Trigonometry,' etc., etc.

ANSWERS TO EXERCISES.

CHAPTER VI.

1. 348,951.
2. 1,717,625.
3. 1,292,025.
4. 2,383,876.
5. 5,267,328.
6. 3,651,648.
7. 1,869,246.
8. 2,953,782.
9. 3,274,668.
10. 7,635,250.
11. 20,056,202.
12. 18,610,872.
13. 291,570,981.
14. 238,571,382.
15. 18,074,980.
16. 12,047,841.
17. 104,076,246.
18. 175,072,068.
19. 30,173,049.
20. 46,333,920.
21. 56,165.
22. 674,248.
23. 1,638,442.
24. 3,948,743.
25. 1,386,450.
26. 278,984.
27. 18,205,155.
28. 54,834.
29. 97,290.
30. 787,737,208.
31. 540,000.
32. 490,530.
33. 9,729.
34. 12,782¼.
35. 1,672¼.
36. 121,800¼.
37. 1,122¼.
38. 1,236,717,889.
39. 2,822,400.
40. 47,900,160.
41. 2.
42. 1.
43. 0.
44. 8.
45. 9.
46. 0.
47. 4.
48. 0.
49. 2.
50. 0.

CHAPTER VII.

1. 289.
2. 529.
3. 625.
4. 841.
5. 1,225.
6. 1,369.
7. 1,681.
8. 2,809.
9. 4,225.
10. 4,356.
11. 5,329.
12. 5,625.
13. 6,241.
14. 6,561.
15. 6,889.
16. 7,569.
17. 487,204.
18. 793,881.
19. 628,849.
20. 2,250,000
21. 1,229,881.
22. 2,277,081.
23. 651,249.
24. 502,681.
25. 3,613,801.
26. 11,881.
27. 390,625.
28. 13,225.
29. 11,664.
30. 16,641.
31. 63,001.
32. 261,121.
33. 477,481.
34. 1,671,849.
35. 1,418,481.
36. 2,244,004.
37. 62·5681.
38. 6806·25

39. ·9604.
40. ·00627264.
41. $\frac{8,952,064}{81}$.
42. $\frac{982,081}{49}$.
43. $\frac{15,976,009}{36}$.
44. $\frac{24,920,064}{25}$.
45. $\frac{324,180,025}{9}$.
46. $\frac{483,025}{49}$.
47. $\frac{441}{1,600}$.
48. $\frac{75,625}{324}$.
49. $\frac{986,049}{3136}$.
50. $\frac{1,225}{2,304}$.

CHAPTER VIII.

1. 42,875.
2. 103,823.
3. 328,509.
4. 1,404,928.
5. 226,981.
6. 1,906,624.
7. 1·685159.
8. 456·533.
9. ·001601613.
10. ·007880599.
11. 26·463592.
12. 6257·773.
13. 2,738.
14. 5,072.
15. 1,808.
16. 3,250.
17. 20,288.
18. 55,658.
19. 14,032.
20. 22,698.
21. 20,553.
22. 6,344.
23. 37,400.
24. 3,100.
25. 883.
26. 11,713.
27. 11,635.
28. 19,600.
29. 5·6.
30. ·018.
31. 17,486.
32. 83,512.
33. 4,104.
34. 15,128.
35. 260,532.
36. 121,240.
37. 58,500.
38. 17,080.
39. 106,750.
40. 52,850.
41. 338.
42. 72.
43. 800.
44. 242.
45. 50.
46. 200.
47. 18.
48. 1,250.
49. $\frac{16,517}{36}$.
50. $\frac{1,001}{400}$.

CHAPTER XIV.

TO DIVIDE BY 99, 999, 101, 1,001

83. Let us have to divide 372,685 by 99. We will write the dividend in another form, when the method will be apparent

$$\begin{aligned} 5 &= 5 \\ 80 &= 80 \\ 600 &= 6 \times 99 + 6 \\ 2{,}000 &= 20 \times 99 + 20 \\ 70{,}000 &= 700 \times 99 + 7 \times 99 + 7 \\ 300{,}000 &= 3{,}000 \times 99 + 30 \times 99 + 30 \end{aligned}$$

The remainder evidently consists of 5 + 6 + 7 (the digits in the odd places, counting the units as the first digit) and (8 + 2 + 3) tens (the digits in the even places), but since these tens and units contain another 99, the remainder will not be 48 but 49. Now if we look at the other parts of the numbers we see there are 6 (3rd digit) + 7 (5th digit), and these with the 1 we got from the 148 give us 14 units of ninety-nines. Carrying the ten we have this 1 (carried) + 2 (4th digit) + 3 (6th digit) or 6 tens of ninety-nines. We have only 7 hundreds of ninety-nines and lastly 3 thousands of ninety-nines.

To condense this: 372,685 ÷ 99.

To get units of remainder, 5 + 6 + 7 = 18, but this 8 must not be written down till we know whether the tens of the remainder contain another ninety-nine.

To get tens of remainder, 1 (carried) + 8 + 2 + 3 = 14, the ten in the 14 shows us we must add one to the units

To get units of quotient, 1 (carried) + 6 + 7 = 14
„ tens „ „ 1 „ + 2 + 3 = 6
„ hunds. „ „ 0 „ + 7 = 7
„ thous. „ „ 0 „ + 3 = 3

hence 372,685 ÷ 99 = $3{,}764\frac{49}{99}$ = 3,764·49.

84. Similarly to divide by 999, splitting up each element, except the last 3 figures, into multiples of 999, &c., we should find that we had to add every third figure instead of every second as we did in dividing by 99—

e.g., 4,768,912,134 ÷ 999

For units of remainder, 4 + 2 + 8 + 4 = 18, but again we must see if the hundreds of the remainder contain another 999 before we can write down the 8.

For tens of remainder, 1 (carried) + 3 + 1 + 6 = 11
„ hunds. „ 1 „ + 1 + 9 + 7 = 18

hence the 8 (units) must be increased by 1.

For units of quotient, 1 (carried) + 2 + 8 + 4 = 15
„ tens „ „ 1 „ + 1 + 6 = 8
„ hunds. „ „ 0 „ + 9 + 7 = 16
„ thous. „ „ 1 „ + 8 + 4 = 13
„ tens of thous. „ 1 „ + 6 = 7
„ hund. of thous. „ 0 „ + 7 = 7
„ millions „ „ 0 „ + 4 = 4

∴ 4,768,912,134 ÷ 999 = $4{,}773{,}685\frac{819}{999}$ or 4,773,685·819.

85. To divide by 101, *e.g.*, 47689372 ÷ 101, let us again split up the elements (greater than ten) of the dividend into multiples of 101 and we shall at once see how the result can be written down.

$$\begin{aligned} 2 &= 2 \\ 70 &= 70 \\ 400 &= 4 \times 101 - 4 \\ 9{,}000 &= 90 \times 101 - 90 \\ 80{,}000 &= 800 \times 101 - 8 \times 101 + 8 \\ 600{,}000 &= 6{,}000 \times 101 - 60 \times 101 + 60 \\ 7{,}000{,}000 &= 70{,}000 \times 101 - 700 \times 101 + 7 \times 101 - 7 \\ 40{,}000{,}000 &= 400{,}000 \times 101 - 4000 \times 101 + 40 \times 101 - 40 \end{aligned}$$

To get units of remainder, 2 − 4 + 8 − 7 = −10 + 9 with − 1 to carry to the tens, since I have taken a ten to render the number positive, but again we must not write this number down, until we know whether the tens of the remainder either contain another 101 or whether a hundred and one has to be added to make it positive.

To get tens of remainder, − 1 (carried) + 7 − 9 + 6 − 4 = − 10 + 9; here again we have to add on a hundred and one in the form of ten tens plus one to make the number positive, we must therefore add on one to the remainder which will become 100.

To get units of quotient, − 1 (carried) + 4 − 8 + 7 = 2
„ tens „ 0 „ + 9 − 6 + 4 = 7
„ hunds. „ 0 „ + 8 − 7 = 1
„ thous. „ 0 „ + 6 − 2 = 2
„ tens of thous. „ 0 „ + 7 = 7
„ hunds. of thous. „ 0 „ + 4 = 4

hence 47,689,472 ÷ 101 = $472{,}172\frac{100}{101}$.

86. It may somewhat perplex the student to find a hundred and one written for a hundred in that which we borrow to make the tens of the remainder positive, but it is borrowed from the units of the quotient, which represent so many hundreds and ones. Had

the tens of the remainder been some number larger than ten, as 17, we should have had then to subtract one from the units of the remainder as 101 is contained in any number, as 167, 1 and 66 (not 67) over.

87. Similarly to divide by 1,001, we must first add and then subtract every third figure, taking the same care with the units of the remainder—

e.g., 4,768,973,546,121 ÷ 1,001

For units of remder.		$1-6+3-8+4=-10+4-x$
,, tens ,,	-1 (carried)	$+2-4+7-6=-10+8$
,, hunds. ,,	-1 ,,	$+1-5+9-7=-10+7$

hence $x = -1$ or 1 must be added to 784.

For units of quotient,	-1 (carried)	$+6-3+8-4$	$=6$
,, tens ,,	0 ,,	$+4-7+6$	$=3$
,, hunds. ,,	0 ,,	$+5-9+7$	$=3$
,, thous. ,,	0 ,,	$+3-8+4$	$=-10+9$
,, tens of thous. ,,	-1 ,,	$+7-6$	$=0$
,, hunds. of thous. ,,	0 ,,	$+9-7$	$=2$
,, millions ,,	0 ,,	$+8-4$	$=4$
,, tens of mills. ,,	0 ,,	$+6$	$=6$
,, hunds. of mills. ,,	0 ,,	$+7$	$=7$
,, thous. of mills. ,,	0 ,,	$+4$	$=4$

hence $4,768,973,546,121 \div 1,001 = 4,764,209,336\frac{785}{1001}$

88. No doubt a very little practice would enable students to write down the quotient, beginning with the higher denomination; thus, the first figure of the quotient in the Example in 67 would be 4, and all we have to do is to subtract 4 from the 8 (the fourth figure) and divide 7,649. The second figure will be 7 and after the 7 is subtracted from the nine we have to divide 6,427, and then 4,213 and so on.

89. EXAMPLES IX.

1. 989 ÷ 99.
2. 673 ÷ 99.
3. 4,567 ÷ 99.
4. 6,842 ÷ 99.
5. 59,741 ÷ 99.
6. 35,024 ÷ 99.
7. 69,037 ÷ 99.
8. 642,860 ÷ 99.
9. 135,195 ÷ 99.
10. 1,998,476 ÷ 99.
11. 4,280,731 ÷ 99.
12. 8,674,539 ÷ 99.
13. 4,719 ÷ 999.
14. 8,327 ÷ 999.
15. 47,390 ÷ 999.
16. 82,156 ÷ 999.
17. 98,476 ÷ 999.
18. 231,405 ÷ 999.
19. 864,257 ÷ 999.
20. 730,182 ÷ 999.
21. 924,680 ÷ 999.
22. 7,438,616 ÷ 999.
23. 1,439,762 ÷ 999.
24. 65,870,942 ÷ 999.
25. 897 ÷ 101.
26. 965 ÷ 101.
27. 1,234 ÷ 101.
28. 4,976 ÷ 101.
29. 97,063 ÷ 101.
30. 99,384 ÷ 101.
31. 390,814 ÷ 101.
32. 497,794 ÷ 101.
33. 500,179 ÷ 101.
34. 1,000,000 ÷ 101.
35. 9,081,726 ÷ 101.
36. 89,705,631 ÷ 101.
37. 2,468 ÷ 1,001.
38. 9,001 ÷ 1,001.
39. 15,406 ÷ 1,001.
40. 78,420 ÷ 1,001.
41. 35,218 ÷ 1,001.
42. 900,101 ÷ 1,001.
43. 500,500 ÷ 1,001.
44. 728,728 ÷ 1,001.
45. 5,471,202 ÷ 1,001.
46. 7,377,370 ÷ 1,001.
47. 69,870,005 ÷ 1,001.
48. 391,064,287 ÷ 1,001.
49. 123,456,789 ÷ 9,999.
50. 987,654,321 ÷ 10,001.

CHAPTER X.

SQUARE AND CUBE ROOT.

90. Since the square of a single digit contains either 1 or 2 figures, and that of 2 digits 3 or 4, and that of 3 digits 5 or 6 digits, &c., &c., we must count the figures whose root is to be extracted, and if there is an odd number, the digit of the highest denomination will be 1, or 2, or 3. If there be an even number of digits, the digit of the highest denomination in the root will be 4, 5, 6, 7, 8, or 9.

91. The squares of the first nine numbers must be known, viz., 1, 4, 9, 16, 25, 36, 49, 64, 81, it will be noticed that 2^2 and 8^2 $(10-2)$ end in the same figure, and similarly with all the complementary pairs. This is unfortunate as (supposing the number is known to be a square number) we cannot write down the units at once, as we shall see we can in cube root.

92. $(a+b)^2 = a^2 + 2ab + b^2$
$= a^2 + (2a + b)\,b.$

In the case of extracting the square root of 3 or 4 figures, having found the first figures (the tens) by inspection, we can easily find the units by dividing the remainder, (after subtracting the square of the tens from the original number) by twice the tens digit of the root.

e.g. $\sqrt{2209}$.

(1) The units will be 3 or 7, but we cannot yet tell which.

(2) There being 4 figures, the tens of the root will be the root of the nearest square number to 22, viz., 16. Now $22 - 16 = 6$, which with 09 affixed make 609, and this divided by 2×40 or 80 gives us 7; hence we write down 47.

93. Had we been asked to find the square root of a number with 5 figures; we should first write down the hundreds of the roots, which we can see by inspection, we then double this and divide the remainder (after subtracting the square of the hundreds of the root) by twice the hundreds of the roots, and having found the tens we can proceed as before and so find the units, and the last figure will verify the unit figure of the root.

e.g. $\sqrt{56,169}$.

The 5 shows that the hundreds in the root must be 2, and $56,169 - 40,000 = 16,169$, and 400 is contained in this so nearly 40 times, that it is wiser to put down 3 for the tens. Now $23^2 = 529$, and $561 - 529 = 32$, which with 69 affixed is 3269, in which 460 is evidently contained 7 and not 3 times, hence $\sqrt{56,169} = 237$.

94. If the number (supposing it to be a square number) end in 5, the tens figure will be 2, and the unit figure of the root will be 5; hence $\sqrt{5625} = 75$. Since 49 or 7^2 is the nearest square number to 56.

95. If three figures are asked for in an approximate root we must proceed as above; *e. g.*, $\sqrt{2{\cdot}71}$ to 3 figures; the first figure is 1 unit and 20 will go into 171 not more than six times, and 16^2, or 256, subtracted from 271 leaves 15, and $1500 \div 32$ gives us 4, the third figure required; hence $\sqrt{2{\cdot}71} = 1{\cdot}64$.

96. Assuming that the number is a perfect cube, whose cube root is asked for, it is very easy to write down the cube root of any number of 6 or even 9 figures. Since the cubes of the first 10 numbers are 1, 8, 27, 64, 125, 216, 343, 512, 729 and 1000, the units of which are all different, we know at once (provided, as I said before, that we know that the number is a cube number) the unit figure.

97. We must imagine the number divided off into periods of 3 figures, and we can at once write down the units and tens of the root, if there be not more

than six figures, and the units and hundreds if there be more than six and less than ten figures. If there be say eight figures we must know that $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$, which suggests at once the method of finding b, namely, square the hundreds figure of the root and multiply it by 3, and then divide the remainder after the cube of the hundreds has been subtracted from original number thus:

98. Assuming that 56623104 is a cube number, let us write down its cube root. We know that since 56 is between 27 and 64 the hundreds figure of the root is 3, and since the last figure is 4 the units of the root must be 4. To find the tens subtract 27,000,000 from 56,623,003, and divide the remainder 29,623,000 by $3 \times 90{,}000$, which giving a quotient of more than 10, we have to consider whether the figure will be 9 or 8.

99. The following considerations may help us to determine whether the tens be 8 or 9: $64 - 27 = 37$ and this $\div 10$ is nearly 4. ∴ there will be about a difference of 4 for every extra unit in the corresponding figure of the root, and $64 - 56 = 8$, ∴ the number will be $10 - 2$ or 8 ∴ the cube root required is 384.

100. If a, b, c be in continued proportion $\frac{a}{b} = \frac{b}{c}$ or $b^2 = ac$, and b is called a mean proportional between a and c.

101. To write down the mean proportional between two numbers it is unwise to multiply them together, and then extract the square root; but look for the factors in the two numbers which are repeated, and each pair must have a corresponding one in the mean proportional, thus:

102. Find the mean proportional between 2695 and 1980. We see 5 is a factor in each, and is contained 539, and 396 times respectively. We also see that 11 is a factor in each, and is contained 49 and 36 times respectively; both of which are square numbers ∴ the mean proportional required is $5 \times 11 \times 7 \times 6$ or 2310.

103. EXAMPLES X.

Find.

1. $\sqrt{529}$.
2. $\sqrt{1,369}$.
3. $\sqrt{2,401}$.
4. $\sqrt{3,249}$.
5. $\sqrt{9,409}$.
6. $\sqrt{14,641}$.
7. $\sqrt{116,964}$.
8. $\sqrt{228,484}$.
9. $\sqrt{346,921}$.
10. $\sqrt{388,129}$.
11. $\sqrt{471,969}$.
12. $\sqrt{266,256}$.
13. $\sqrt{467,856}$.
14. $\sqrt{1,038,361}$.
15. $\sqrt{4,141,225}$.

Find correct to 2 places of decimals.

16. $\sqrt{4{\cdot}9}$.
17. $\sqrt{6{\cdot}4}$.
18. $\sqrt{8{\cdot}1}$.
19. $\sqrt{12{\cdot}1}$.
20. $\sqrt{14{\cdot}4}$.

Find a mean proportional between the following ten pairs of numbers.

21. 847 & 1,008.
22. 1,980 & 2,695.
23. 5,376 & 6,804.
24. 1,715 & 4,235.
25. 4,928 & 13,013.
26. 448 & 847.
27. 448 & 567.
28. 1,650 & 3,234.
29. 4,928 & 1,925.
30. 657 & 1,168.

Find.

31. $\sqrt[3]{12,167}$.
32. $\sqrt[3]{103,823}$.
33. $\sqrt[3]{912.673}$.
34. $\sqrt[3]{1,771,561}$.
35. $\sqrt[3]{15,069,223}$.
36. $\sqrt[3]{61,162,984}$.
37. $\sqrt[3]{116,930,169}$.
38. $\sqrt[3]{53,157,376}$.
39. $\sqrt[3]{111,980,168}$.
40. $\sqrt[3]{794,022,776}$.
41. $\sqrt[3]{117,649} - \sqrt[3]{59,319}$.
42. $\sqrt[3]{2,924,207} + \sqrt[3]{1,404,928}$.
43. $\sqrt[3]{7,880,599} - \sqrt[3]{2,352,637}$.
44. $(\sqrt[3]{75,686,967} - \sqrt[3]{35,287,552})^2$
45. $(\sqrt{170,569} - 2\sqrt[3]{704,969})^2$
46. $\sqrt[3]{\frac{50,653}{3,241,792}}$.
47. $\left\{\sqrt{\frac{39,601}{1,940,449}}\right\}^3$
48. $\sqrt[2]{32,761} \times \sqrt[3]{421,875}$.
49. $\frac{\sqrt[3]{1,442,897}}{\sqrt[2]{12,996}}$
50. $\frac{\sqrt[2]{12,996}}{\sqrt[3]{1,520,875}} \times \frac{\sqrt[3]{12,167}}{\sqrt[2]{3,249}}$

CHAPTER XI.

MULTIPLYING A SUM OF MONEY BY 365, &c.

104. Remembering that £1 = 240d., 10s. = 120d. we can split up 365 into 240 + 120 + 5.

For every penny which we have to multiply we must have £1 and 10s. (or half as many pounds again) to which we must add 5 times the sum, thus:—

14s. 4d. × 365.

14s. 4d. × 5 = £[3] 11s. 8d.

14s. 4d. = 172 and $172 \times 1\frac{1}{2} = 258$

∴ 14s. 4d. × 365 = £261 11s. 8d.

of course the three must not be written down but carried in the head.

105. If the number of pence is odd there will be 10s. to add to the result of multiplying the sum by 5, thus: 17s. 5d. × 365

17s. 5d. × 5 + 10s. = £[4] 17s. 1d.

17s. 5d. = 209 and $209 \times 1\frac{1}{2} = 313\frac{1}{2}$

but the $\frac{1}{2}$ can be neglected here as it has already been accounted for

∴ 17s. 5d. × 365 = £317 17s. 1d.

106. Since $\frac{3}{4}$d. = 7s. 6d.

If $\frac{1}{4}$d., $\frac{1}{2}$d., or $\frac{3}{4}$d. appear in the sum to be multiplied we must add 7s. 6d., or 15s., or £1 2s. 6d. to the product of the sum of money and 5 according as the farthings are 1, 2, or 3, thus

4s. $7\frac{1}{4}$d. × 5 + 10s. + 7s. 6d. = £[2] 0s. $6\frac{1}{4}$d.

4s. 7d. = 55d., $55 \times 1\frac{1}{2} = 82\frac{1}{2}$, but the $\frac{1}{2}$ has been accounted for

∴ 4s. $7\frac{1}{4}$d. × 365 = £84 0s. $6\frac{1}{4}$d.

107. To multiply a sum of money by any number, all we have to do is to resolve the number of pence contained in the sum into the sum or difference of a multiple of twelve and some number less than 12; or the number of shillings, if there are no pence, into the sum or difference of a multiple of 20 and some number less than 20, thus:

4s. 7d. × 100 = 4s. 7d. × (8 × 12 + 4)

4s. 7d. × 4 = 18s. 4d.

4s. 7d. = 55d.

and $55d. \times 8 \times 12 = 55 \times 8s.$ or £55 × $\frac{8}{3}$

∴ 4s. 7d. × 100 = £22 18s. 4d.

108. Or we might multiply 4s. 7d. by 100 thus

7d. × 100 = (7 × 8 × 12 + 7 × 4) pence

= 56s. + 2s. 4d.

and 4s. × 100 = £4 × $\frac{100}{20}$ = £20

∴ 4s. 7d. × 100 = £22 18s. 4d.

109. Multiply 4s. 7½d. by 239. 239 = 240 − 1.
4s. 7½d. = 55½d.; 55½d. × 240 = £55 10s. 0d.
and £55 10s. 0d. − 4s. 7½d. = £54 5s. 4½d.

110. If farthings appear in the sum to be multiplied by 100, the operation is sometimes performed thus:

4s. 7¼d. × 100. 4s. 7¼d. = 221 farthings
221 far. × 100 = 221 × 96 far. + 221 × 4 far.
= 221 × 2s. + 221 pence

or twice as many shillings and as many pence as there are farthings, but unless the number of farthings is small, I doubt if this method is as short and as easy as the other.

111. In the answers, hints will be given in all doubtful cases as to the best method to adopt.

112. EXAMPLES XI.

Find the wages of—

1.	365 days	at	3s.	6d.	a day	26.	366 art.	at	2s.	4d.	each
2.	,,	,,	4s.	7d.	,,	27.	367 ,,		2s.	4½d.	,,
3.	,,	,,	2s.	3d.	,,	28.	369 ,,		3s.	7½d.	,,
4.	,,	,,	3s.	9d.	,,	29.	231 ,,		4s.	6¾d.	,,
5.	,,	,,	5s.	11d.	,,	30.	1cwt. 8lbs.	at	2s.	5d.	lb.
6.	,,	,,	6s.	7d.	,,	31.	1cwt. 7lbs.	at	3s.	6d.	,,
7.	,,	,,	2s.	2½d.	,,	32.	1cwt. 9lbs.	at	4s.	2½d.	,,
8.	,,	,,	0s.	3¾d.	,,	33.	2cwt. 16lbs.	at	3s.	7½d.	,,
9.	,,	,,	4s.	7½d.	,,	34.	2cwt. 17lbs.	at	4s.	2½d.	,,
10.	,,	,	11s.	9½d.	,,	35.	2cwt. 15lbs.	at	3s.	11¾d.	,,
11.	100 art.	at	0s.	2½d.	each	36.	3cwt. 24lbs.	at	2s.	9½d.	,,
12.	,,	,,	0s.	7½d.	,,	37.	3cwt. 23lbs.	at	3s.	11½d.	,,
13.	,,	,,	1s.	4d.	,,	38.	97 art.	at	0s.	2½d.	each
14.	,,	,,	2s.	5d.	,,	39.	193 ,,		2s.	11d.	,,
15.	,,	,,	8s.	8½d.	,,	40.	191 ,,		3s.	4½d.	,,
16.	,,	,,	4s.	7¾d.	,,	41.	432 ,,		2s.	9d.	,,
17.	,,	,,	5s.	11½d.	,,	42.	431 ,,		3s.	7¾d.	,,
18.	,,	,,	6s.	8½d.	,,	43.	70 doz. yds.	at	4½d.	yd.	
19.	,,	,,	17s.	2d.	,,	44.	96 doz. lbs.	at	4¼d.	lb.	
20.	,,	,,	19s.	1½d.	,,	45.	50 scores pigs, at		55s.	ea.	pig
21.	252	,,	3s.	6½d.	,,	46.	77 ,, ,,		at 46s.	3d.	,,
22.	239	,,	4s.	7¾d.	,,	47.	36 ,, melons,		at 4½d.	ea.	mel.
23.	241	,,	5s.	6d.	,,	48.	456 art.	at	3s.	9½d.	each
24.	97	,,	3s.	3¾d.	,,	49.	840 ,,		2s.	4½d.	,,
25.	49	,,	15s.	2½d.	,,	50.	246 ,,		6s.	8¾d.	,,

(To be continued.)

—o—

Government Examination of Pupil Teachers.

END OF FOURTH YEAR.

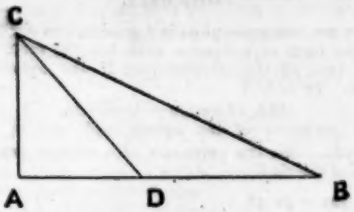
Euclid.

BOYS ONLY.

1. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts together with twice the rectangle contained by the parts.
Bk. II. prop. 4.

2. In every triangle the square on the side subtending an acute angle is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall upon it from the opposite angle, and the acute angle.
Bk. II. prop. 13.

3. Divide a given straight line into two parts, such, that the square on one part shall be twice the square on the other.



3. At A draw AC at right angles to AB (I. 11).
At B make an angle ABC equal to one-fourth of a right angle (I 23). Let AC and BC meet at C (ax. 12).
From AB cut off AD equal to AC (I. 3).
Then the straight line AB is divided as required at D.
For the angles ACD and ADC are equal, and each ½ right angle (I. 5, I. 32).
And ADC is equal to DBC and DCB (I. 32).
But DBC is one-fourth of a right angle.
Therefore DCB is one-fourth of a right angle, and DC = DB. (I. 6).
Now the square on DC = the sum of the squares on AD and AC, that is, twice the square on AD.
Therefore the square on DB = twice the square on AD.
Therefore AD and DB are the parts required.

Algebra.

BOYS ONLY.

1. Simplify $\frac{x^2-7x+10}{x^2-5x+6}$ and $\frac{2a}{a+b}+\frac{2b}{a-b}+\frac{a^2+b^2}{a^2-b^2}$

$$\frac{x^2-7x+10}{x^2-5x+6}=\frac{(x-5)(x-2)}{(x-3)(x-2)}=\frac{x-5}{x-3}$$

$$\frac{2a}{a+b}+\frac{2b}{a-b}+\frac{a^2+b^2}{a^2-b^2}$$

$$=\frac{2a(a-b)+2b(a+b)+a^2+b^2}{a^2-b^2}$$

$$=\frac{2a^2-2ab+2ab+2b^2+a^2+b^2}{a^2-b^2}$$

$$=\frac{3a^2+3b^2}{a^2-b^2}=\frac{3(a^2+b^2)}{a^2-b^2}$$ Ans.

2. Resolve into factors $3+6a^2x+3a^4x^2$, and $mnx^2+m^2xy+n^2xy+mny^2$. Find the greatest common measure of x^4+x^2-20, and x^4-5x^2+4.

$3+6a^2x+3a^4x^2=(1+a^2x)(3+3a^2x)$
$mnx^2+m^2xy+n^2xy+mny^2=(nx+my)(mx+ny)$
$x^4+x^2-20=(x^2+5)(x^2-4)$
$x^4-5x^2+4=(x^2-1)(x^2-4)$
x^2+5 and x^2-1 have no common factor
∴ the G.C.M. $=\underline{x^2-4}$. Ans.

3. Solve the simultaneous equations

$$\frac{x}{2}+\frac{y}{3}=1,\ \frac{x}{4}-\frac{2y}{3}=3$$

A hall is 14 feet longer than it is broad, and its area is 1800 square feet; what is its breadth?

(a) $3x+2y=6$ (b) $3x-8y=36$.

Subtract (b) from (a)

$3x+2y=6$
$3x-8y=36$
$10y=-30$
$y=-3$

Substitute the value of y in b,
Then $3x+24=36$
$3x=12$
$x=4$

$\underline{x=4,\ y=-3}$. Ans.

Let x be the breadth in feet of the hall. Then the length $=x+14$.

Area of hall $=x+(x+14)=1800$
i.e., $x^2+14x=1800$
Add 7^2 to each side $x^2+14x+49=1849$
Extr. sq. rt. of each side $x+7=\pm 43$
∴ $x=\pm 43-7=36$ or -50

but -50 cannot be the required root in this case
∴ Answer $=\underline{36}$.

Mensuration.

BOYS ONLY.

1. There are two grass plots in a garden, one circular and the other in the form of a square, each has the same perimeter. Find the area of the circular plot if the square contains 22 sq. yds. ($\pi = \frac{22}{7}$.)

Side of square $= \sqrt{22}$ yds.

$\therefore$ The perimeter of the square and also of the circle $= 4\sqrt{22}$ yds. But the perimeter of a circle $= 2\pi r$ where r is the radius of the circle.

$$\therefore 2\pi r = 4\sqrt{22}$$

$$r = \frac{4\sqrt{22}}{2\pi} = \frac{4\sqrt{22}}{2 \times \frac{22}{7}} = \frac{2 \times 7}{\sqrt{22}} = \frac{14}{\sqrt{22}}$$

Area of a circle $= \pi r^2 = \frac{14}{\sqrt{22}} \times \frac{14}{\sqrt{22}} \times \frac{22}{7} = 14 \times 2 = \underline{28 \text{ yds.}}$

2. Regular hexagons are inscribed in circles whose radii are 3 ft. and 5 ft. What is the area of the circle in which the area of the inscribed hexagon is a mean proportional between the areas of the two former hexagons? ($\pi = \frac{22}{7}$.)

The hexagon contains 6 equilateral $\triangle$s, each having its sides equal to the radius of the circumscribed circle.

$\therefore$ Area of hexagon = 6 times area of each triangle.

Area of equilateral $\triangle$ OBC $= BC \times \frac{1}{2} OD$

$$= BC \times \tfrac{1}{2}\sqrt{OB^2 - BD^2}$$

$$= BC \times \tfrac{1}{2}\sqrt{OB^2 - \frac{OB^2}{2^2}}$$

$$= 3 \times \tfrac{1}{2}\sqrt{3^2 - \frac{3^2}{2^2}}$$

$$= 3 \times \tfrac{1}{2}\sqrt{\frac{36-9}{4}} = 3 \times \tfrac{1}{4}\sqrt{27}$$

$$= 3^2 \times \tfrac{1}{4}\sqrt{3}$$

$\therefore$ Area of 1st hexagon $= 6 \times 3^2 \times \frac{\sqrt{3}}{4}$

Similarly area of 2nd hexagon $= 6 \times 5^2 \times \frac{\sqrt{3}}{4}$

Mean proportional between these two hexagons

$$= \sqrt{(6^2 \times 3^2 \times 5^2 \times \tfrac{3}{16})}$$

$$= 6 \times 3 \times 5 \times \frac{\sqrt{3}}{4}$$

$\therefore$ Area of each of the 6 triangles constituting the 3rd hexagon $= 3 \times 5 \times \frac{\sqrt{3}}{4}$

Square of the side of the 3rd hexagon $= \frac{15 \times \frac{\sqrt{3}}{4}}{\frac{\sqrt{3}}{4}} = 15$

= square on the radius of the circle.

$\therefore$ Area of the third circle $= 15 \times \frac{22}{7} = \frac{330}{7} = \underline{47\tfrac{1}{7} \text{ sq. ft.}}$ Ans.

Arithmetic.

GIRLS ONLY.

1. Find the average of $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{11}{12}$.

L. C. D. = 12.

$$\frac{6+8+9+10+11}{12} = \tfrac{44}{12}; \quad \tfrac{44}{12} \div 5 = \frac{\overset{11}{\cancel{44}}}{\underset{3}{\cancel{12}}} \times \tfrac{1}{5} = \tfrac{11}{15}$$

2. Find the income produced by investing £1115 10s. 0d. in the three per cents. @ 97.

$$\frac{£1115\ 10s.\ 0d.}{97} \times 3 = \frac{£3346\ 10s.\ 0d.}{97} = \underline{£34\ 10s.}$$

3. What is meant by discounting a bill? which party is benefited by reckoning *interest* as *discount*?

A person has a bill due say some months hence, but he wants the money now. The person that discounts the bill advances the amount of the bill less a sufficient sum to pay him interest on the sum he pays until the bill becomes due.

The discounter reaps the benefit by deducting the interest on the full amount of the bill for the given time, and at the rate decided on, instead of *the interest on the* PRESENT WORTH *of the bill* (True Discount) which of course is less than *the interest on the full amount* (*i.e.*, the Banker's Discount).

Show the amount of the error in discounting a bill for £150, due four months hence, @ 5% per annum, if interest is reckoned as discount.

Interest on £150 for 4 months @ 5%

$$= \frac{150 \times \frac{1}{3} \times 5}{100} = £2\ 10s. = \text{Banker's Discount.}$$

Interest on £100 for 4 months @ 5% = £1 13s. 4d.

$\therefore$ Present worth of £100 = £98 6s. 8d.

As 100 : 150 :: £98 6s. 8d. :: Pres. worth of £150.

$$\frac{£98\ 6s.\ 8d. \times 3}{2} = £148.$$

Interest on £148 for 4 months @ 5%

$$= \frac{\overset{37}{\cancel{148}} \times \frac{1}{\cancel{3}} \times \overset{5}{\cancel{5}}}{\underset{5}{\cancel{20}}} = £\tfrac{37}{15} = £2\ 9s.\ 4d. \quad £2\ 10s. - £2\ 9s.\ 4d. = \underline{8d.}$$

4. The 1st, 3rd, and 4th terms of a proportion sum are 3·6, 2·75, 75·38; find the second term.

As 3·6 : x :: 2·75 : 75·38

$$x = \frac{75{\cdot}38 \times 3{\cdot}6}{2{\cdot}75} = \frac{7538}{275} \times 3\tfrac{3}{5} = \frac{7538 \times 18}{825} = 16\tfrac{458}{825}$$

75)7538(100·506

75·

·380

375

·500

450

·50

100·506. Ans.

Geography.

BOYS AND GIRLS.

1. State what you know about Boston (Massachussetts), Chicago, New Orleans, San Francisco, Salt Lake City, Portland (Maine), St. Louis, Richmond (Virginia).

Boston, named after the Pilgrim Fathers who came from Lincolnshire, is the second town for trade and the chief literary town in the States. It is famous for its public schools and libraries.

Chicago, on L. Michigan, a city built of wood and which has consequently been burnt down several times, is famous for its rapid growth in trade and population.

New Orleans, at the mouth of the Mississippi River, is the Metropolis of the Gulf States and the greatest cotton market in the world.

San Francisco is the chief port of California; its importance arose from the discovery of gold. It is the terminus of the Pacific Railway and has considerable trade with China.

Salt Lake City, on the Great Salt Lake in the 'Great Basin of Utah,' is famous for being the Mormon Metropolis.

Portland, one of the earliest settlements in the New England States; it is engaged in shipbuilding and the lumbering trade.

St. Louis, on the Mississippi near the confluence of the Missouri, has a great inland trade.

Richmond, at the head of James River has extensive tobacco factories.

2. Give a full account of the Indian Ocean, and enumerate the chief groups of islands in that Ocean.

The Indian Ocean, the smallest of the great Oceans, is bounded on the west by Africa, on the north by Asia, and on the east by the East Indian Isles and Australia. Its southern

limit is the Antarctic Circle. The coast line is mostly of an unbroken character, there being no harbours along the African, Australian or Burmese coasts. On the north, however, there are the following arms of the sea, the Red Sea, the Persian Gulf, Arabian Sea, and Bay of Bengal. Arabia, India, Siam, and the Somali district are peninsulas dividing its waters. It receives from Africa the waters of the Limpopo and Zambezi, from Asia the Tigris and Euphrates, the Indus, Nerbudda, Taptee, Godavery, Ganges, Irrawady; from Australia only the Swan River and the Darling.

A cold drift current passes up by the west coast of Australia and crosses the ocean as an Equatorial current; part of this passes up round the shores of the bay of Bengal and part finds its way through the straits between the East Indian Islands into the China Sea; the Equatorial current is joined again by the Bengal current and bifurcates at the north of Madagascar, part passing south by the east of Madagascar, the rest flowing through the Mozambique channel. At the Cape of Good Hope the current turns to the east and crosses as a Counter Current to the coast of Australia. The south-west Monsoons blow from April to October, and the north-east Monsoons from October to April. At the changing of the Monsoons Cyclones are common.

The following are the chief groups of Islands:—Madagascar with the Mauritius, Bourbon, the Seychelles, Amirante Isles, Socotra, these are off the coast of Africa. The Laccadive and Maldive Isles lie to the south-west of India. Ceylon is to the south-east of India. In the Bay of Bengal lie the Andaman and Nicobar Islands. Sumatra and Java are the largest of the East Indian Isles in this Ocean.

3. Explain the phrases *Annular* and *Total Eclipse* of the Sun, and the phrase *Mean Solar Time*.

The Sun is not always at the same distance from the Earth at the time of an Eclipse, neither is the moon; consequently the length of the cone of space obscured by the moon's intervention varies. Sometimes the Sun does not enter this cone and then there is no eclipse; again the Sun enters the tip of the cone but the cone's diameter is less than that of the Sun, and so the centre only of the Sun is hidden and a ring of light is seen. This is called an Annular or Ring-like eclipse, from Latin *annulus*, a ring. But at other times the Sun passes into the aforesaid cone and is lost from our sight completely for a time. This is a *Total Eclipse*.

Mean Solar Time.—In consequence of the obliquity of the ecliptic and the ellipticity of the Earth's orbit the Earth does not travel at the same rate throughout the year, it travels faster when nearer the Sun than when farther away. Consequently the length of the days as marked by the Sun varies. This inequality in the length of the day is inconvenient for business purposes, consequently an imaginary star called the Mean Sun is supposed to travel uniformly round the equator in the same time that the Earth travels round the Ecliptic. Thus the days are of the same length. It will be seen that sometimes this will be in advance of, and sometimes behind the Real Solar Time.

The time by this Mean Sun is called *Mean Solar Time*.

Arithmetic.

BOYS ONLY.

1. What is the length of a side of a square room which is covered by 206¼ yds. of carpet 33 inches wide?

yds. ft. in.
206 0 9
3
618
12
7425
33
22275
22275
245025(495
16
89)850
801
985)4925
4925

inches
12)495
3)41 . 3
13 . 2

13 yds. 2 ft. 3 in. Ans.

2. Simplify $\frac{\frac{3}{4}+\frac{7}{17}}{\frac{17}{19}+\frac{2}{3}} \times \frac{\frac{5}{13}+\frac{1}{3}}{\frac{2}{3}+\frac{5}{13}}$

$$\frac{34+21}{51} \times \frac{133}{28+76} \times \frac{40+11}{55} \times \frac{104}{117+16}$$

$$= \frac{55}{51} \times \frac{133}{104} \times \frac{51}{55} \times \frac{104}{133} = 1$$

3. If I make 17½ per cent. profit by selling goods @ 19s. 7d. per ton, at what price per ton should I sell them to make 25 per cent. profit?

What simple illustrations would you use in explaining the term percentage of profit to a class?

As $117\frac{1}{2} : 125 :: 19s.\ 7d. :$

$$\frac{2}{235} \quad \frac{2}{250} \quad \frac{12}{235}$$

d.

$$\frac{235 \times 250}{235} = 250d. = \underline{£1\ 0s.\ 10d.}$$

(*b*) Suppose a lad had 100 pennies and went to the market and bought oranges which he sold. When he came to count up how much he had received he finds he has 120 pence. He has then gained 20 pence by spending 100 pence. That is a profit of 20 per 100 or 20 per cent. Then take 200 with say a profit of 20 on the 200, and ask what that would be on 100. Then proceed to such numbers @ 85, 250, and find the percentage by proportion.

4. Find the Compound Interest for 3 years @ 2 per cent. per annum on £9375.

$\frac{£9375 \times 2}{100} = \frac{18750}{100} = £187\ 10s.$ ∴ Principal for 2nd year = £9375 + £187 10s. = £9562 10s.

$\frac{£9562\ 10s. \times 2}{100} = \frac{19125}{109} = £191\ 5s.\ 0d.$ ∴ Principal for 3rd year = £9562 10s. + £191 5s. = £9753 15s.

$\frac{£9753\ 15s. \times 2}{100} = \frac{£19507\ 10s.}{100} = \underline{£195\ 1s.\ 6d.}$ Ans.

History.

BOYS AND GIRLS.

1. What were the circumstances in which the Scots took part in the Civil War against Charles I., and, later on, on behalf of Charles II.?

Charles I. followed the policy of his father towards Scotland in his endeavours to establish Episcopacy. In 1633 he appointed 13 Bishops, and in 1637 commanded the use of Laud's Service Book.

This was received by the Scots with defiance. In February and March, 1638, nineteen-twentieths of the nation signed the 'National Covenant' binding themselves to defend the true religion. A Scottish army under Alexander Leslie crossed the border and seized Newcastle.

Six years later the Parliaments of England and Scotland made a solemn League and Covenant, the Scots particularly stipulating for the abolition of Prelacy and Uniformity of Religion.

After the execution of the King in 1649, the Scots proclaimed Charles II., saying that they had taken up arms, not to overturn a throne, but to maintain the Presbyterian worship.

2. State what you know of the Triple Alliance, the Treaty of Dover, the Peace of Utrecht, and the Treaty of Paris. Give date in each case.

(*a*) *The Triple Alliance* (1668) was an arrangement between England, Sweden, and Holland, against the French Monarch (Louis XIV.) He was beginning to be attracted by the Netherlands, to which he had, or professed to have, a claim through his wife.

(*b*) *The Treaty of Dover* (1670). While professing hostility to Louis XIV., Charles II. was secretly in the pay of that monarch. At Dover a secret treaty was signed, the principal terms of which were, (1) that Charles should openly declare himself a Roman Catholic; (2) that he should fight for Louis against the Dutch Republic, and (3) that he should support the claims of that monarch on Spain. Louis promised plenty of money, and an army to quell a possible revolt of the English.

(*c*) *The Peace of Utrecht* (1713). By this treaty, France engaged to acknowledge the protestant succession of the House

of Hanover and to abandon the cause of the Pretender: that the crowns of France and Spain should never be united; and that the fortifications of Dunkirk should be demolished. Then followed a re-adjustment of foreign and other possessions.

(*d*) *The Treaty of Paris.* There are four treaties bearing this name.

(1) Signed in 1763, closing the Seven Years' War. It confirmed the cession to England of Canada by France, and of Florida by Spain. Havannah and the Philippines were restored to the latter.

(2) Signed in 1814. Napoleon was to retire to Elba. The boundaries of France were to be the same as in 1792. England retained Malta, Tobago, St. Lucia, and Mauritius.

(3) Signed in 1815. Napoleon was to retire to St. Helena. The boundaries of France were to be the same as in 1790.

(4) Signed in 1856, at the close of the Crimean War.

3. When were the Test and Corporation Acts passed? What were their objects and provisions, and when were they repealed?

(*a*) The *Test Act* was passed in 1673. All persons holding public appointments were compelled to receive the Sacrament of the Lord's Supper, according to the usage of the Church of England, and to take an oath against transubstantiation. It was repealed in 1828.

(*b*) The *Corporation Act* was passed in 1661. All magistrates and officers of corporations were to communicate in the Episcopal Church, to renounce the Covenant, and to take the oath of non-resistance. It was repealed in 1828.

4. State briefly what is meant by the following terms:—

(*a*) *A Member of Parliament* is a man chosen by the electors of a district to represent them in Parliament.

(*b*) *The Government* consists of a body of advisers chosen by the Sovereign from both Houses of Parliament. It is responsible to Parliament for the conduct of affairs and for the advice it gives the Sovereign.

(*c*) *The Cabinet* is formed by the *chief* members of the Government or Ministry. It determines the general policy of the Ministry and the Measures to be proposed to Parliament.

It consists necessarily of—(1) The Premier, or First Lord of the Treasury. (2) The Lord Chancellor. (3) The Chancellor of the Exchequer. (4) The Home Secretary. (5) The Foreign Secretary. (6) The Colonial Secretary. (7) The Indian Secretary. (8) The Secretary of War. (9) The President of the Privy Council.

(*d*) *The Prime Minister* is the head of the Ministry. He owes his office to the confidence of his supporters in Parliament.

The Sovereign chooses as Premier the recognized head of the political party which has a majority in the House of Commons, and intrusts him with the task of forming a Ministry from among his supporters.

(*e*) *The Assizes*, a Court *in England*, held in every county by special commission to one of the judges who is called a justice of the Assize, and empowered to take Assizes, that is, the verdict of a jury.

Teaching.

BOYS AND GIRLS.

1. What visible illustration can you suggest for explaining the way to find the true remainder when division is performed by breaking up the divisor into factors?

Take 89 to be divided by 12.

$$\begin{array}{r} 3)89 \\ 4)\underline{29} + 2 \\ \cdot 7 + 1 \end{array}$$

Ans. $7 + \dfrac{1 \times 3 + 2}{4 \times 3}$ *i.e.* 7 and 5 over.

Now count out upon a table 89 *penholders*. Place them first of all in groups of *threes*, we shall see then that we have 29 such groups, and 2 odd ones. Now treat each of these 29 groups as a unit, and arrange them in groups of 4 each so that each group has 12 penholders in it; we shall then have 1 group of three left. This 3 together with the 2 odd ones we had before make up the 5 remaining.

This illustrates the rule, which is, *multiply the first divisor by the second remainder, and add the first remainder.*

Thus $\underline{(3 \times 1) + 2}$.

2. What are the chief faults to be avoided in respect of the slant or slope of the down strokes of the writing of your eldest scholars? (*a*) The irregularity of slope. (*b*) Making them blotchy instead of gradually increasing or vanishing. (*c*) Painting instead of making clear strokes. (*d*) Not making the strokes of d's and g's touch the 'o' of those letters; or else running them through the 'o.'

3. Mention half a dozen examples of the way in which careless or indistinct articulation leads to bad spelling.

Asting for asking. *Track* for tract. *Picksher* for picture. *Middlin'* for middling. *Extryordinary* for extra-ordinary. *Goverment* for government.

4. What help would you give to prevent mistakes in words containing the sound variously written ie, ei, ee, e, I should teach the following rules:—

(*a*) With reference to ie and ei:—

Ei is used only after c, as receive, deceive, &c., except in the word *seize*, in all other cases use ie as believe.

(*b*) With reference to ee and e.

After pre and re write *ede*, but in all other cases write eed as *proceed*, *exceed*, except *supersede*. The derivation will help to fix this last word.

FOR TEACHERS IN INFANT SCHOOLS.

1. Give examples of four of the more difficult joinings which occur in combining letters, and explain how you would, in your writing lessons, teach the children to master those difficulties.

(*a*) To join 'o' on to a preceding letter. (*b*) To join o to a succeeding letter. (*c*) To join the stroke of a 'd' or 'g' to the o. (*d*) To join *b* or *v* to the following letter.

To overcome these difficulties I should prepare special groupings of letters, each grouping requiring several instances of the difficulty to be treated. This could be copied by the children many times over, the teacher passing round and directing the children, and then pointing out on the blackboard any common defects.

2. Write out full notes of a lesson (matter only) on 'A Country Walk.'

State the age of the children for whom the lesson is intended. Let the children be 6 years of age.

We will suppose our walk is on a spring day at the beginning of April.

I. What we *see*.—Cows grazing, horses drawing the plough, men at work in the fields, the brook running along by the roadside, the beautiful primroses and violets in the hedge; the worms turning up the ground, the ants crossing our path, the spider weaving his web among the bushes to catch flies.

II. What we *hear*.—The singing of the birds, the lowing of the cattle, the bleating of the lambs, the buzzing of the insects, the song of the milkmaid, the shout to the horses.

III. What we *smell*.—The fresh turned earth, the lovely flowers.

IV. The lesson learnt. Nothing we see is idle:—Men, women, insects, birds, are all active doing the work God meant them to do.

3. Show that a child may be more readily taught to read correctly if he is first taught to speak correctly, and explain the method in use in your school for teaching the children to speak.

(*a*) Many of our words are pronounced as they are spelt; a child therefore that has learnt to correctly pronounce a word, will sooner detect that word when the letters are before him than a child who has never been in the habit of pronouncing the word as spelt. If a child says '*fink*' for '*think*,' when taught phonetically he will naturally look for 'fink,' whereas the child that knows how the sound 'th' is expressed in letters and has been in the habit of saying 'think' will have no difficulty in reading the word.

(*b*) Teach the vowel sounds as they are pronounced in the alphabet.

Take *a* and practise this with several of the consonants most easily sounded, as b, l, m, p. When this vowel is satisfactorily sounded, take *e* and treat it similarly, and so with the rest.

When the vowels are secured, take the other consonants, reserving r, th, st, and other difficult consonants till the easier ones are mastered.

Try to get the children to give you from their little vocabulary words that have in them the sound they are practising.

Grammar.

BOYS AND GIRLS.

1. *Go*, lovely *rose*,
Tell her *that* wastes her time and *me*,
That now she knows
When I resemble her to thee
How sweet and fair she seems *to be*.

Give the meaning of this passage in your own words.

Thou beautiful rose, I send thee to her whose indolent beauty makes me pine away with love, that she may see in thy loveliness and fragrance an emblem of the image she produces on my heart.

2. Analyze the whole, and parse the words in italics

No. of Sentence	Kind	Connective	Subject	Predicate	Object	Extension of Predicate
A	Principal		Thou (understood) (Lovely Rose name of person addressed)	Go		
B	Principal cop. co-ord. with A.		Thou	tell	her	
C	Subordinate adjective sent. qualifying *her*		That	wastes	her time and me	
D	Subordinate object sent. governed by tell	That	she	knows		now (time)
E	Subordinate adverb of time modifying knows	when	I	resemble	her (direct) to thee (indirect)	
F	Subordinate noun sent. object of knows	How	she	seems to be sweet and fair		

Go—intrans., strong verb, act., imper., pres., sing., 2nd, agreeing with thou (understood).
rose—com. noun, sing., neuter, nom. case of address.
Tell—trans., strong-weak verb, act., imper., pres., sing., 2nd, agreeing with thou (understood).
that—rel. pron., sing., fem., 3rd, nom. case to wastes.
me—pers. pron., sing., mas., 1st, obj. case by wastes.
That—subord. conj., joining 'you tell' and 'she knows.'
How—indirect interrog. adverb of degree modifying sweet.
sweet—adj. of qual., pos. degree, qual. person (understood).
to—preposition, sign of the infinitive mood.
be—intrans., strong verb, pres., infinitive, gov. by seems.

3. Take these words :—impose, repose, compose, interpose, depose, expose, propose, superpose, and use each in a separate sentence of your own framing. Point out the exact meaning of each, and say what part of the meaning is common to all, and how that meaning is affected by the prefix in each case.

The word *pose* in all these words means 'place' or 'put' and is derived from the Latin word *pono* (pp. positus) I place or put.

Word	Sentence	Meaning of the Word
Impose	They *impose* a heavy tax on sugar.	Place *on*
Repose	I shall *repose* a while	Place (myself) *back*
Compose	He *composes* Sacred music	Puts (it) *together*
Interpose	The senator *interposed* his veto	Placed (it) *between*
Depose	They will *depose* the king	Put (him) *down*
Expose	Butchers *expose* their meat for sale	Place (it) *out*
Propose	We *propose* to go	Put (this) *forth* (for discussion)
Superpose	This layer *superposes* that	Lies *above* it or is placed *above* it

4. Name three eminent dramatists, three eminent poets, and three eminent historians who have lived in England. Say when they lived and what they wrote.

(*a*) Dramatists. (1) *William Shakespeare*, born 1564, died 1616. Wrote 35 plays, including 'Hamlet,' 'King Lear,' 'Romeo and Juliet,' 'Taming the Shrew,' and the 'Merchant of Venice,' besides some sonnets and poems.

(2) *Ben Jonson*, born 1573, died 1637. Began writing comedies, his works include :—'Every Man in his Humour,' 'Every Man out of his Humour,' 'Cynthia's Revels,' 'The Poetaster,' 'Sejanus,' 'Volpone (a Masque),' and 'Bartholomew Fair.'

(3) *John Dryden*, born 1631, died 1700. His works include the following plays :—'Wild Gallant,' 'The Rival Ladies,' 'The Indian Queen,' 'The Indian Emperor,' 'The Spanish Friar,' 'Aurenge Zebe,' 'Hind and Panther.'

(*b*) Poets. (1) *Geoffrey Chaucer*, born 1328, died 1400. He translated French works into English prose. The 'Court of Love,' 'Assembly of Foules,' 'Complaint of the Black Knight,' and the 'Canterbury Tales' are among the most notable of his poetical works.

(2) *Edmund Spenser*, born 1552, died 1599. The 'Shepheardes Calendar,' 'Fairy Queen,' and 'Daphnaida' are the most noticeable.

(3) *John Milton*, born 1608, died 1674. Besides many prose essays he wrote 'Paradise Lost,' 'Paradise Regained,' 'Lycidas,' 'Samson Agonistes' and many other poems.

(*c*) Historians. (1) *Sir Walter Raleigh*, born 1552, died 1618. 'Fragment of the History of the World, from the Creation to the end of the Macedonian War.

(2) *David Hume*, born 1711, died 1776. 'History of the Reigns of the Tudors, James I., Charles I., to the Revolution,' also 'Natural History of Religion.'

(3) *Thomas Babington Macaulay*, born 1800, died 1859. 'Critical and Historical Essays' and 'History of England.'

END OF FIRST YEAR.

Music.

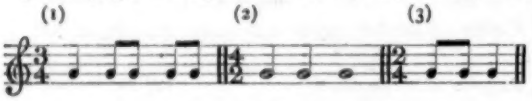
STAFF NOTATION.

1. (1) Re-write the following, halving the value of every note, and (2) state below each its pitch name (as C or *Do* &c.):

2. Write below each of the following intervals its name (major second, &c.):

Minor third. Major or perfect fourth. Minor sixth.

3. Add proper time-signatures to each of the following bars:



TONIC SOL-FA NOTATION.

1. Q. Name the intervals formed by the following:—
   A. (1) *me* to *lah*, major or perfect fourth, (2) *me* to *te*, major or perfect fifth, (3) *doh* to *lah*, major sixth, (4) *doh* to *fah*, major or perfect fourth.

2. Q. State what measures are shown by the following pulse signs:—
   A. (1) | s :— | : d' | m : d | : ||

   Four-pulse measure.

   (2) s | f :— | m : r | d :— | — }

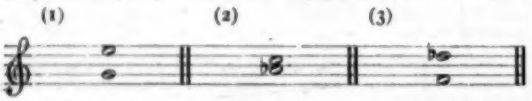
   Secondary two-pulse measure.

3. Q. What notes of the scale are taught in the *Third Step* of the Tonic Sol-fa method?
   A. *fah* and *lah*.

END OF SECOND YEAR.

STAFF NOTATION.

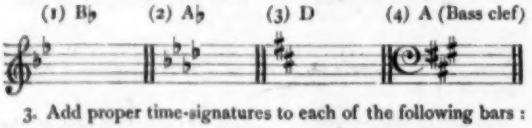
1. Write below each of the following intervals its name (major second, &c.):



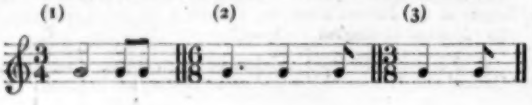
Major sixth Major third Minor sixth

2. Write the signatures of the following major keys:

(1) B♭ (2) A♭ (3) D (4) A (Bass clef)



3. Add proper time-signatures to each of the following bars:



TONIC SOL-FA NOTATION.

1. Q. What is the mental effect (1) of *me*, (2) of *fah*, (3) of *doh*?
   A. (1) Calm, steady, (2) desolate, (3) firm, strong.

2. Q. Name the intervals formed by the following:—
   A. (1) *ray* to *doh*', minor seventh, (2) *fah* to *ray*', major sixth, (3) *ray* to *lah*, major or perfect fifth.

3. Q. Write (1) a four-pulse measure, (2) a three-pulse measure, (3) a nine-pulse measure.

   A. (1) | : | : ||

   (2) | : : ||

   (3) | : : | : : | : : ||

END OF THIRD YEAR.

STAFF NOTATION.

1. Write a diminished (minor or imperfect) fifth above each of the following notes:—

2. Write below the following rests, *notes* equivalent in value:—

3. Explain (briefly) the meanings of the following terms:—

(1) Rallentando.	Gradually slower.
(2) Grazioso.	Gracefully.
(3) Allegretto.	Moderately quick.
(4) Mezzo forte.	Moderately loud.

TONIC SOL-FA NOTATION.

1. Q. Re-write the following, halving the value of every note and rest:—

| d :d.m | s :-.d' | d' :— | : d' ||

A. | d.d,m : s.,d' | d' : .d' ||

—o—

Model Answers to Scholarship Questions.

Midsummer, 1886.

BY. A. BARRIBALL, B.A.

Grammar.

1. Analyze fully the first five lines of this stanza and parse the words printed in italics.

Milton! thou shouldst be living at this hour:
England *hath need* of thee; she is a fen
Of stagnant waters; altar, sword, and pen,
Fireside, the heroic wealth of hall and bower,
Have forfeited their ancient English dower
Of inward happiness. *We are* selfish *men*;
Oh! raise us up; return to us again;
And give us manners, virtue, freedom, power.
Thy soul was *like a star*, and dwelt apart;
Thou hadst a voice *whose sound* was like the sea;
Pure as the naked heavens, majestic, free,
So *didst thou travel* on life's common way,
In cheerful godliness; and yet thy heart
The lowliest *duties* on herself *did lay*.

No. of Sent.	Kind	Connective	Subject	Predicate	Object	Extension of Predicate
A	Principal		(Milton N. of Ad.) Thou	shouldst be living		at this hour (time)
B	Principal illative co-ord. with A.	(For)	England	hath	need of thee	
C	Principal cop. co-ord. with B.		She	is a fen of stagnant waters		
D	Principal cop. co-ord. with B and C.		Altar, sword, pen, fireside, the heroic wealth of hall and bower	have forfeited	their ancient English dower of inward happiness	

hath—trans., weak verb (contracted), act., indic., pres., sing., 3rd, agreeing with England.
need—abstr. noun, sing., neutr., 3rd, obj. case by hath.
We—pers. pro., plur., mas., 1st, nom. case to are.
are—intrans., mixed verb, indic., pres., plur., 1st, agr. with we.
men—com. noun, plur., mas., 3rd, nom. case in appos. with we.
like—adj. of qual., qual. soul (or *thing* understood).
a—indef. art. or adj. of distinction lim. star.
star—com. noun, sing., neutr., 3rd, dat. case gov. by like.
whose—rel. pro., sing., neutr., 3rd (agreeing with antec. voice), poss. case gov. by sound.
sound—com. noun, sing., neutr., 3rd, nom. case to was.
didst—aux. verb, sign of past tense } act., indic., past., 2nd, sing., agr. with thou.
travel—intrans., weak verb, act., infin., gov. by didst.
thou—pers. pron., sing., mas., 2nd, nom. case to didst travel.
duties—com. noun, plur., neutr., 3rd, obj. case by did lay.
did—aux. verb, sign of past tense. } act., indic., past., sing., 3rd, agr. with heart.
lay—trans., weak verb, act., infin., gov. by did

2. Paraphrase the foregoing extract, and select from it any example of words or phrases which are not used literally, but as 'figures of speech.'

Oh! Milton, would you were alive now. Our land is sorely in need of such men; everything is in a state of stagnation; all progress is wanting, society is rotten at the core, the church, the army, literature, family life, the wealth and beauty of which characterized the baronial mansions of old, have all lost their happiness and brightness. Selfishness is now the prevailing passion. Revisit then this earth and restore our race to its former character by improving our habits, raising our morals, and promoting the liberty of our people and the greatness of our land.

Isolated as your life was, it was nevertheless the guiding star of your generation; your words had a weird but wonderful power; you trod the path of life with unsullied steps, never stooping to baseness, but cheerfully obeying your Maker in all things; but dignified as you were, never did you shirk a duty however humble.

Figures of Speech. She is a fen of stagnant waters. *Metaphor.*
Altar, fire, sword, fireside, &c. *Metonymy.*
Thy soul was like a star. *Simile.*
Pure as the naked heavens. *Simile.*
So did'st thou travel on life's common way. *Metaphor.*
Thy heart the lowliest duties on herself did lay. *Metaphor.*

3. Name six of the most famous English writers. Say when each of them lived, and what books he wrote.

Spencer (1553-1598). — 'Shepherd's Calendar,' 'Faerie Queen.'
Shakespeare (1564-1616).—Thirty-five plays, sonnets, and poems.
Milton (1608-1674).—'Paradise Lost,' 'Paradise Regained,' 'Comus,' 'Lycidas,' 'Samson Agonistes,' and many prose and Latin works.
Dryden (1631-1700).—'Absalom and Achitophel,' 'Alexander's Feast,' &c., &c.
Cowper (1731-1800).—'The Task,' 'Mother's Picture,' &c., &c.
Byron (1753-1828).—'Childe Harold's Pilgrimage,' 'Siege of Corinth,' &c.

4. Take each of the following words, and add to it a prefix or a suffix. Explain in each case what change in the meaning of the word has been effected by the additional syllable :—

just admire faith pure brother
friend sincere wise hard speak

Word	Word with Prefix or Affix	Change Made
Just	Unjust	Negatived the meaning.
Admire	Admiration	Turned from verb to noun.
Faith	Faithful	,, ,, noun to adj.
Pure	Purity	,, ,, adj. to noun.
Brother	Brotherhood	,, ,, com. noun to abst. noun.
Friend	Friendship	,, ,, ,, ,, ,, ,, ,,
Sincere	Insincere	Negatived the meaning.
Wise	Wisdom	Turned from adj. to abstract noun.
Hard	Hardship	,, ,, ,, ,, ,, ,,
Speak	Bespeak	From meaning *to talk*, it now means to *order beforehand.*

5. Explain each of the following grammatical terms, and give an example illustrating its use :—

infinitive relative apposition government predicate
dative subjunctive transitive inflection

The *infinitive* (Lat. *in*, not; *finio*, I finish) is that part of the verb which names the action; it is a verbal noun, before which 'to' is expressed or understood, but it lacks the essential attribute of a verb which is to make a statement. It is because it is unlimited with regard to number and person that it is called the *infinitive*. *E.g.*, I like *to see* a game of cricket.

Relative (Lat. *re*, back; *latus*, borne) is the term applied to those pronouns, adjectives, and adverbs which refer back to some word previously expressed. That is the *house* in *which* I was born.

Apposition (Lat. *ad*, at; *positus*, placed) is employed when a noun is placed by the side of another to define it, limit its signification, or add to the information about it. *E.g.*, Henry the Third, *King* of England. Your brother, the *doctor*.

Government (Fr. *gouverner*, to govern; Lat. *gubernor*, a helmsman) is the influence which one word exercises upon another.

E.g., He saw the *boy*. *Boy* is *governed* into the obj. case by saw.
Whose hat. Whose is governed into the poss. case by hat.

Predicate (Lat. *praedico*, I declare) is that part of the sentence which asserts something about the subject. We *will send* a subscription.

Dative (Lat. *datus*, given) is the term applied to the case of the indirect obj. which is used after verbs signifying giving and the like. We taught *him* geography.

Subjunctive (Lat. *sub*, under, and *jungo*, I join) is the name of the mood employed when the verb expresses a supposition merely and not a fact. If he *were* here, I *should be* happy.

Transitive (Lat. *trans*, across, and *eo*, I go).—Verbs are said to be transitive when they pass over from an agent to an object. *I* saw your *friend*.

Inflection (Lat. *in*, in, and *flecto*, I bend) is a change made in the form of words to express variety of number, gender, voice, tense, &c.

Man, *men*; child, *child's*; run, *ran*; do, *did*.

6. Show by examples the different uses which may be made in English of the words 'what' and 'that.' Parse the sentence:

'What seemed his head.
The likeness of a kingly crown had on.'

What do you want? Interrog. pronoun.
What a sight! Exclamatory adjective.
What noise is that? Interrogative adjective.
Give me *what* I asked for. Relative pronoun.
I asked him *what* he wanted. Indirect interrogative pronoun.
What with their talking and laughing, I could not think. Adverbial use in the sense of partly.
That boy. Demonstrative adjective.
I said *that* you were wrong. Conjunction.
That is mine. Demonstrative pronoun.
I saw the book *that* you speak of. Relative pronoun.

7. If you think there is anything wrong in any of the following sentences, correct it, and give your reasons:—

(*a*) I should have liked to have seen so fine a sight.

(*b*) I do not think him a reliable person.

(*c*) There let him lay.

(*d*) Preferring to know the worst, than to dream the best.

(*e*) The courage of the soldier and of the citizen are essentially different.

(*f*) Each thought of others rather than themselves.

(*g*) The orator spoke of the notion that the national debt might be repudiated with absolute contempt.

(*a*) Use *to see* instead of *to have seen*; because the wish is not that the seeing should be *completed*, but *progressing* at the time indicated.

(*b*) Quite right; but may be varied by 'I do not think that he is a, &c.'

(*c*) *lay* is the past tense of *lie*, but the infinitive has no *past* form; it should be 'let him lie.'

(*d*) Should be 'preferring to know the worst, to dreaming the best,' or 'preferring to know the worst, rather than to dream the best.' Preferring must be followed by 'to' or '*rather* than.'

(*e*) Two different kinds of courage are spoken of, and therefore a plural is felt to be wanted, but the first rule of concord is broken thereby. The sentence is best re-written:
There is an essential difference between the courage of the soldier and that of the citizen.

(*f*) Should be, each thought of others rather than *himself*. *Each* being distributive refers to only one person at a time.

(*g*) Should be, 'the orator spoke with absolute contempt of the notion,' &c.
The adverbial phrase is too far removed from the verb it modifies.

8. How do you account for the presence in English of so many words of Latin origin? Say by what token—either as regards spelling or construction—you can recognise that an English word is derived from Latin; and give some examples.

(*a*) The Roman conquest and occupation of Britain caused a number of military terms to be introduced, as street, camp.
The introduction of Christianity from Rome introduced ecclesiastical terms.
The Norman conquest introduced many Latin words, though modified by the French tongue.
All our old scholars were learned in Latin, and consequently expressed new thoughts in Latin words.
The advancement in learning and science has also added many Latin terms.
The intercourse with Spain, and the Italian influence at court during the Elizabethan reign, gave us many modified Latin words.

(*b*) Most words of two or more syllables are of Latin origin. Also, nearly all words beginning with Latin prefixes, as in, con, sub, &c., or ending in *ate*, tion, ment, tious, ous, able, ity. *E.g.*, insubordination, arbitrament, ambitious, affable, facility. These words too have a regularity of pronunciation; *i.e.*, they contain none of those varieties we meet with in English words, as *dough*, *thought*, *hough*, *bough*, *enough*.

Geography.

(2) What parts of Great Britain are distinguished from the rest: (*a*) as the flattest; (*b*) as the most elevated; (*c*) as the most beautiful; (*d*) as the richest in minerals; (*e*) as the most populous? Give details.

(*a*) The *flattest*.—The district round the Wash (The Fens), including parts of Lincoln, Cambridge, Rutland, Northampton, and Norfolk. The Eastern Counties of England generally. In Scotland, Strathmore in Perth, and Forfar.

(*b*) The *most elevated*.—In Wales, Carnarvon, Merioneth, and Cardigan, containing Snowdon and Cader Idris. In Scotland, the district immediately south of the Caledonian Canal, containing Ben Nevis, Cairntual, &c. In England, Cumberland and Westmoreland, where is Scafell and Helvellyn; and also the West of Yorkshire, where the Pennine chain contains Crossfell, Whernside, &c.

(*c*) The *most beautiful*—In Wales, Merioneth (Barmouth), Carnarvon, and Denbigh (Llandudno). In England, the coast of Devonshire (Torquay and Ilfracombe); the lake district in Cumberland and Westmoreland. In Scotland, the fiords of the west, and the Trosachs in the south of Perthshire.

(*d*) The *richest in minerals*.—In England, coal and iron in Northumberland, Durham, Lancashire, West Riding of Yorkshire; copper, lead, and tin in Devon and Cornwall. In Scotland the Lowther Hills and district extending from Forth to Clyde: here coal, iron, and lead are found. In Wales, coal and iron in South Wales, round Merthyr Tydvil.

(*e*) *Most populous*.—The great manufacturing centres—In England, West Riding of Yorkshire, Tyne Valley, South Lancashire, Warwick and Staffordshire, Middlesex; South Wales. In Scotland the most populous district is in the lower basin of the Clyde.

(3) State what you know about each of the undermentioned places:—Aden, Florence, the Campagna, the Deccan, the Fens, the Black Country, the Peak, Londonderry, the Trosachs, Coventry, Plymouth, and Bristol.

Aden.—A coaling station in possession of the British, situated on the Gulf of Aden, in the south of Arabia, near the entrance to the Red Sea; it is very useful for ships passing through the Suez Canal to India.

Florence, on the Arno, in Italy, is a beautiful city, and the birthplace of Dante. It was at one time the capital of Italy.

The *Campagna* is the name given to the plain round Naples, which is exceedingly fertile.

The *Deccan* is a triangular plateau in the south of India, bounded on the north by the Vindyah Hills, and on the east and west by the Ghauts.

The Fens are flat marshy districts in the counties bordering on the Wash.

The Black Country is the name given to that part of Warwick and Staffordshire which is engaged in smelting. The sooty atmosphere and refuse of the furnaces lying in every direction account for the name.

The Peak is the name given to the highest hill in Derbyshire. It is of limestone, and under it are some splendid caverns.

Londonderry, at the mouth of the Foyle, in the north of Ireland, is renowned for the siege it sustained. It has important manufactures.

The Trosachs is the name applied to the beautiful upper course of the Forth. Sir Walter Scott's 'Lady of the Lake' made them notorious.

Coventry, in Warwickshire, is the central town of England, and is engaged in the iron trade; it is also engaged in the silk manufacture.

Plymouth, on Plymouth Sound, is the largest town in the West of England. It is an important port, and possesses a government dockyard.

Bristol, on the Avon, in Somerset, is one of the chief cities of England; its trade, however, since the decline of the sugar manufacture, is not so great as formerly.

(4) Name eight of the most famous buildings in the world, and add any descriptive or historical facts which you know respecting them.

(*a*) *St. Paul's Cathedral*, the largest Protestant cathedral in the world; a church first built on this site 610, burnt 1083; restored, but burnt down 1666. Sir Christopher Wren designed the present structure, which was completed 1711.

(*b*) *The Escurial*, in Madrid, the grandest and most costly royal palace in the world. It was founded by Philip II., and is built in the form of a gridiron. It is adorned with tapestry, statuary, and jewels of priceless value. Connected with it is a mausoleum, a church, and a convent.

(*c*) *The Leaning Tower of Pisa*, in Tuscany, is 188 feet high, divided into eight storeys, each surrounded by 38 pillars of marble. A plummet let down from the top falls 15 feet from the base of the tower.

(*d*) *St. Peter's Church at Rome*, built in the form of a cross, and of perfect symmetry and proportion, is the most wonderful and perfect building in the world.

(*e*) *The Imperial Winter Palace of St. Petersburgh* is one of the largest and most magnificent palaces in the world. The Duke of Edinburgh was married here in 1874.

(*f*) *The New York Post Office*, built of white marble in 1871, at a cost of £700,000.

(*g*) *The Seraglio, or Royal Palace of the Sultan of Turkey*, occupies, with its grounds, an area with a circuit of more than three miles. It was burnt down in 1863.

(*h*) *The House of Congress*, the House of Parliament of the United States; foundation laid by Washington, 1792; destroyed by British, 1814; but restored in 1825. Its main building is of freestone, but the additional wings are of white marble. The building is 737 feet long, and covers 3½ acres.

5. Describe a voyage to Calcutta by the Suez Canal, and say what a traveller is likely to see on such a voyage.

Starting from Charing Cross Station, we travel to Dover, and crossing the Straits to Calais, we proceed by railway through Paris and Lyons to the Mont Cenis Tunnel, and, on emerging into Italy, cross the plain of Lombardy, and pass down the east coast of Italy to Brindisi. Here we take ship again and steam direct to Port Said, passing the Delta of the Nile, with the towns of Alexandria, Rosetta, and Damietta. We now enter the Canal, which is cut through a desolate, barren, cloudless region, and are thankful when we arrive at Suez, the town at the other end of the Canal. Passing down the Red Sea, we observe a low ridge of hills near the coast on our right. *Massowah*, on the border of Abyssinia, is the only town worth noticing. We now pass into the Gulf of Aden, by the Strait of Babel Mandeb, noting Perim Isle in the Strait. We now call at Aden to replenish our coal supply, and then sail direct across the Arabian Sea, and passing Cape Comorin, at the south of India, reach Point de Galle in the south of Ceylon. Here again we take in coal, and then sail north to the mouth of the Ganges, and entering the chief mouth, the Hoogly, we steam up it to Calcutta.

6. Show as fully as you can whence we obtain our supplies of silk, mahogany, wine, cheese, oranges, spice, maize, and dried fruit and wheat respectively.

PRODUCT	WHENCE OBTAINED
Silk	France, China, India.
Mahogany	Honduras, British Guiana, and the West Indies generally.
Wine	France (Bordeaux), Spain and Portugal (port and sherry), Italy, Cape Colony, and Australia.
Cheese	Cheshire, Holland, Ireland, Switzerland, America.
Oranges	Spain (Seville), Portugal, Malta, Asia Minor.
Spice	East Indian Islands, Ceylon.
Maize	British North America and the United States.
Dried fruit	Greece, Ionian Islands, Asia Minor.
Wheat	Canada, Russia (Odessa), Australia.

7. Explain, as to an upper class of children, the difference in time between London and Cairo, or between London and New York, and the reasons for the difference.

Look at the map. Observe the longitude of London, Cairo, and New York. We see they are approximately 0°, 30° E., and 75° W., respectively.

Now the earth turns on its axis once in 24 hours, and by so doing brings in the course of 24 hours every line of longitude immediately under the sun. But as the earth turns from W. to E., the line of longitude furthest to the E. is brought beneath the sun before that to the west of it; but when a line of longitude has the sun vertically over some point in it, it is noon at all places along that line. Thus at Cairo it is noon *before* it is at London, and at New York it is noon *after* it is at London.

Now for the amount of difference.

The earth rotates through 360° in 24 hours, *i.e.* through 15° in one hour, ∴ Cairo has the sun $\frac{30}{15} = 2$ hours *before* London. and New York has the sun $\frac{75}{15} = 5$ hours *after* London. *E.g.*, if it is 12 o'clock mid-day at London, it is 2 p.m. at Cairo, and 7 o'clock in the morning at New York.

Arithmetic.

Male Candidates only.

1. (*a*) State the rule for finding the least common multiple of two numbers, and prove it (as to a class) for the numbers 65 and 78.

Find the G. C. M. of the two numbers, divide both numbers by the G. C. M. and then obtain the product of the G. C. M. and the two quotients obtained. This product is the L. C. M.

e.g., G. C. M. of 65 + 78 is 13

13)65, 78

5, 6

L. C. M. = 13 × 5 × 6 = 390.

It will be found that no less number will contain both these numbers.

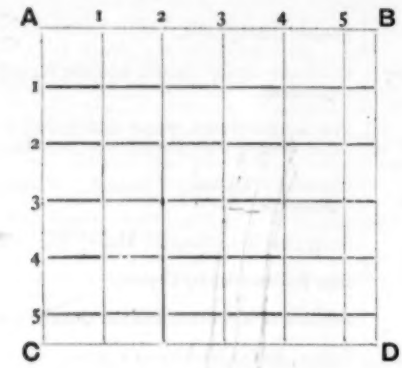
(*b*) Prove that $\frac{3}{4} = \frac{9}{12}$.

A twelfth is one-third of one-fourth, *i.e.*, there are 3 twelfths in 1 fourth; I must therefore have 3 times as many twelfths as fourths.

We see then that if we multiply the denominator of a fraction by any number, we do not alter the value of the fraction *provided we multiply the numerator by the same number.* Thus

$$\frac{3}{4} \times \frac{3}{3} = \frac{9}{12}.$$

(*c*) Show by a diagram that $30\frac{1}{4}$ square yds. make a sq. pole, a pole being $5\frac{1}{2}$ yds. long.



It will be seen that we have 25 squares, each with its sides 1 yd. long; also 10 oblongs 1 yd. by $\frac{1}{2}$ yd.; *i.e.*, 10 half-square yds. = 5 sq. yds.

Also at D a little square with $\frac{1}{2}$ yd. each side, *i.e.*, $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ sq. yd. Thus the whole figure = 25 + 5 + $\frac{1}{4}$ = $30\frac{1}{4}$ sq. yds.

(*d*) Prove the rule for finding the vulgar fraction equivalent to $\cdot 2\dot{7}$.

$$\cdot 2\dot{7} = \frac{27 - 2}{90} = \frac{25}{90}.$$

$\cdot 2 = \frac{2}{10}$ $\quad \cdot\dot{7} = \frac{7}{10} + \frac{7}{100} + \frac{7}{1000}$ &c., ad infinitum,

$= \frac{111111}{1000000}$. $\therefore \cdot 0\dot{7} = \frac{111111}{10000000}$

$\frac{10000000}{90} = 111111$ &c.; $111111 \times 7 = 777777$.

Thus we see that approximately $\cdot 0\dot{7} = \frac{7}{90}$

$$\frac{2}{10} + \frac{7}{90} = \frac{18 + 7}{90} = \frac{25}{90}. \qquad \text{Q.E.D.}$$

(*e*) Define ratio, proportion, interest, and discount.

Ratio expresses the number of times one number or quantity contains another.

Proportion is the equality of ratios.

Interest is money paid for the loan of money which is called the principal.

Discount is money deducted from the amount of a bill by one who advances the amount of the bill before the payment of that bill is due.

2. Two equal sums of money are divided, the one amongst 47 men and the other amongst a certain number of women; each man receives £1 4s. 6d., and each woman a shilling less. How many women are there?

$$\frac{£1\ 4s.\ 6d. \times 47}{£1\ 3s.\ 6d.} = \frac{49 \times 47}{47} = \underline{49 \text{ women.}} \quad \text{Ans.}$$

3. Find by practice the cost of 13 cwt. 2 qrs. 23 lbs. 2 oz. 4 drs. at £1 17s. 4d. per quarter.

			£	s.	d.
		1 qr.	1	17	4
					54
			100	16	0
14 lbs.	$\frac{1}{2}$	1 qr.		13	8
7 lbs.	$\frac{1}{2}$	14 lbs.		6	10
2 lbs.	$\frac{1}{7}$	14 lbs.		1	$11\frac{1}{7} = 11\frac{2}{14}$
2 oz.	$\frac{1}{16}$	2 lbs.			$1\frac{23}{112} = 1\frac{23}{112}$
4 drs.	$\frac{1}{4}$	2 oz.			$0\frac{23}{448} = \frac{23}{448}$
			£101	18	$7\frac{23}{448}$

4. Reduce $\frac{4578}{4905}$, $\frac{1308}{2943}$ to their lowest terms, and then divide their difference by their sum.

$$\begin{array}{r|l} 4578 & 4905 \\ 327 & 4578 \\ \hline 1308 & 327 \\ 1308 & \end{array} \qquad \frac{4578 \div 327}{4905 \div 327} = \frac{14}{15}$$

$$\begin{array}{r|l} 1308 & 2943 \\ 1308 & 2616 \\ \hline & 327 \end{array} \qquad \frac{1308 \div 327}{2943 \div 327} = \frac{4}{9}$$

$$\frac{14}{15} - \frac{4}{9} = \frac{126 - 60}{135} = \frac{66}{135} = \frac{22}{45}$$

$$\frac{14}{15} + \frac{4}{9} = \frac{126 + 60}{135} = \frac{186}{135} = \frac{62}{45}$$

$$\frac{22}{45} \div \frac{62}{45} = \frac{\overset{11}{\cancel{22}}}{\underset{45}{\cancel{45}}} \times \frac{\overset{45}{\cancel{45}}}{\underset{31}{\cancel{62}}} = \frac{11}{31} \quad \text{Ans.}$$

5. Find the value of $\frac{3}{4}$ of $\frac{2}{19}$ of £13 6s. + $\frac{2}{3}$ of ·01875 of £9 6s. 8d. − $\frac{1}{11}$ of ·43 of £1 10s.

$$\frac{\overset{3}{\cancel{3}}}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{\underset{19}{\cancel{38}}} \times \overset{84}{\cancel{3192}} + \frac{\overset{1}{\cancel{2}}}{\underset{3}{\cancel{6}}} \times \frac{\overset{625}{\cancel{1875}}}{\underset{\overset{160}{\cancel{100000}}}{80}} \times \overset{28}{\cancel{2240}} - \frac{\overset{5}{\cancel{35}}}{\underset{7}{\cancel{91}}} \times \frac{\overset{3}{\cancel{3}}}{\underset{\overset{6}{\cancel{12}}}{2}} \times \frac{\overset{23}{\cancel{322}}}{\underset{\overset{1}{\cancel{46}}}{2}}$$

$= 252\text{d.} + 28\text{d.} + 23\text{d.} = 303\text{d.} = £1\ 5\text{s.}\ 3\text{d.}$

6. A, B, C start at the same time in the same direction and from the same place in a circular course to run round it. A takes 252 seconds, B 231 seconds, and C 198 seconds to do so. When will they next meet at the place from which they started?

The answer is plainly the least common multiple of the several times, as that will be the lowest number of seconds which will contain each of those numbers without a remainder, ∴ each will have just completed a circuit at that time.

2	252, 231, 198
3	126, 231, 99
3	42, 77, 33
11	14, 77, 11
	14, 7, 1

∴ L.C.M = 14 × 7 × 11 × 3 × 3 × 2 = 19,404.

19,404 seconds after starting. Ans.

7. A can walk round a rectangular field, whose sides (in yards) are 411·6 and 548·8, in the same time that B takes to walk from one corner to the opposite corner and back. Find the ratio of their rates of walking.

Perimeter of rectangle = (411·6 + 548·8) × 2 = 960·4 × 2 = 1920·8 yds.

Diameter of rectangle = $\sqrt{(411{\cdot}6^2 + 548{\cdot}8^2)} = \sqrt{470596}$ yds. = 686 yds.

411·6	548·8
411·6	548·8
24696	43904
4116	43904
4116	21952
16464	27440
169414·56	301181·44

169414·56
301181·44
470596·00
470596 | 686
36
128)1105
1024
1366) 8196
8196

∴ A's rate : B's rate :: 1920·8 : 686 × 2 = 19208 : 13720 = 7 : 5 Ans.

8. If the income tax were $3\frac{1}{3}$ per cent. on a man's income instead of 8d. in the pound, what difference would it make to a man whose annual income is £3,125?

$\frac{3\frac{1}{3}}{100} \times 3\frac{1}{3} = £109\ 7\text{s.}\ 6\text{d.}$

8d. × 3125 = 25000d. = £104 3s. 4d.

∴ He would be a sufferer by £109 7s. 6d. − £104 3s. 4d. = £5 4s. 2d. Ans.

9. If 7 men earn as much in a day as 12 women, and 1 woman as much as 2 boys, and if 7 men, 6 women, and 12 boys, working together for 10 days, earn £21, what will be the earnings of 8 men and 8 women working together for 6 days?

1 woman's wages = $\frac{7}{12}$ that of a man.
1 boy's wages = $\frac{1}{2}$ of a woman's = $\frac{1}{2} \times \frac{7}{12} = \frac{7}{24}$ of a man's.
∴ 7 men's, 6 women's and 12 boys' wages = that of

$$\left(7+6\times\frac{7}{12}+12\times\frac{7}{12}\times\frac{1}{2}\right)\text{men} = 7+\frac{7}{2}+\frac{7}{2}=\frac{14+7+7}{4}=7$$

∴ since 7 men earn £21 in 10 days, 1 man earns £3 in 10 days, *i.e.*, 5s. in 1 day.
∴ 8 men and 8 women in 6 days will earn (5s. + 5s. × $\frac{7}{12}$) × 8 × 6 = (5s. + 2s. 11d.) × 48 = £19 0s. 0d. Ans.

10. A wine glass is filled with a mixture of spirit and water in the ratio of 1 of spirit to 4 of water; another glass of the same size is filled in the ratio of 2 of spirit to 5 of water. Find the ratio of spirit to water when the contents of the two glasses are mixed in a tumbler.

In first wine glass $\frac{1}{5}$ is spirit.
In second wine glass $\frac{2}{7}$ are spirit.

$$\frac{1}{5}+\frac{2}{7}=\frac{5+8}{20}=\frac{13}{20}.$$

Thus we have in the two glasses $\frac{13}{20}$ of a glassfull of spirit.
∴ $2-\frac{13}{20}=1\frac{7}{20}$ glassfulls = the quantity of water in the mixture.
∴ Required ratio is $\frac{13}{20}:\frac{27}{20}=13:27$.

11. Find the true discount on £1,653 8s. 9d. for 4½ months at 4½ per cent. per annum.

£100 / 4½ / 37 10 — 4½ / 150 0 / 25 0 / 1'75 0 / 20 / 15'00

as £101 15s. : 1653 8s. 9d. :: £1 15s. : Ans.

20 / 2035 / 4 / 8140 — 20 / 33068 / 4 / 132275 — 20 / 35

$$\frac{7}{35}\times\frac{12025}{132275}\text{s.}=\frac{84175}{1443}=\text{£}28\text{ 8s. 9d.}$$ Ans.

12. Seven per cent. was lost by selling a carriage for £69 15s., and 4½ per cent. was gained by selling a horse for £94 1s. How much was gained or lost on the whole?

As £100 : £69 15s. :: £7

4 / 400 — 4 / 279

$$\frac{279\times 7}{400}=\frac{1953}{400}=\text{£}4\text{ 17s. }7\tfrac{1}{5}\text{d.} = \text{amount lost.}$$

As £100 : £94 1s. :: £4½

20 / 2000 — 20 / 1881

$$\frac{1881\times 9}{2\times 2000}=\frac{16929}{4000}=\text{£}4\text{ 7s. }7\tfrac{17}{20}\text{d.} = \text{amount gained.}$$

Total result of bargains = £4 17s. 7⅕d. − £4 7s. 7$\frac{17}{20}$d.
= 10s. 0$\frac{3}{20}$d. lost.

13. 684 policemen are to be distributed among three towns in proportion to the population, viz.: 10,944, 12,312, 25,992. How many policemen will be sent to each town?

Total population = 10,944 + 12,312 + 25,992 = 49,248

1st town will have $\frac{10944}{49248}$ of 684 = 152

2nd town will have $\frac{12312}{49248}$ × 684 = 171

3rd town will have 684 − (152 + 171) = 684 − 323 = 361.

14. Find the *exact* compound interest on £3,976 for 2 years at 4 per cent.

$$\frac{\text{£}3{,}976\times 4}{100}=\frac{15904}{100}=\text{£}159\text{ 0s. }9{\cdot}6\text{d.}$$

£3,976 + £159 0s. 9·6d. = £4,135 0s. 9·6d. = principal for second year

£4135 0s. 9·6d. / 4 / 165·40 3 2·4 / 20 / 8·03 / 12 / 0·384

£165 8s. 0·384d. Ans.

15. How much must be invested in the 3 per cents. at 99 to produce the same income as would be obtained by investing £1508 in the 2½ per cents at 87? Neglect brokerage.

$$\frac{\text{£}1508\times 2\frac{1}{2}}{87}=\frac{\overset{754}{\cancel{1508}}\times 5}{87\times 2}=\frac{3770}{87}=\text{£}43\text{ 6s. }8\text{d.}$$

$$\frac{\text{£}43\text{ 6s. }8\text{d}\times\overset{33}{\cancel{99}}}{\cancel{3}}=\text{£}1430.$$ Ans.

Arithmetic.

Females only.

1. Work this sum in Long Division and analyze it in such a way as to show to a class of children the meaning of each line, and the separate value of each figure in the quotient.

Divide £175,869 12s. 4½d. by 23.

£	s.	d.	thous.	hunds.	tens	units
23)175869	12	4½	(7	6	4	6 pounds
161000						
14869						
13800						
1069						
920						
149						
138						

11 = number of pounds over
20 = number of shillings in a pound
232 = no. of shillings in £11 + 12s. in the dividend

	tens	units
23)232(	1	0 shillings
230		

2 = number of shillings over
12 = number of pence in a shilling
28 = no. of pence in 2 shillings + 4d. in dividend

	unit
23)28(	1 pence
23	

5 = number of pence over
4 = number of farthings in 1 penny
23 = no. of farthings in 5 pence + 3 farthings in dividend

	unit
23)23(	1 farthing
23	

£7646 10s. 1¼d. Ans.

2. If 6s. 6d. is gained by selling 26 yds. at 3s. 4½d. per yard, what was the original cost per yard, and what is the gain per cent.?

(3s. 4½d. × 26) − 6s. 6d. = cost of 26 yds. = £4 1s. 3d.
∴ cost of 1 yd. = $\frac{\text{£}4\text{ 1s. }3\text{d.}}{26}$ = 3s. 1½d.

Therefore since 3d. is gained on 3s. 1½d.

s. d.	£	d.	
As 3 1½	: 100 ::	3	: gain per cent.

8 | 20 | 25 | 2000 | 8 | 16000 | 640

$\frac{16000 \times 3}{25}$ = 1920d. = £8. Ans.

3. If the income tax was 7½d. in the pound, what would be the annual income of a gentleman whose tax amounted to £58 1s. 4½d.?

$\frac{£58\ 1s.\ 4\frac{1}{2}d.}{7\frac{1}{2}} \times £1 = \frac{232.1}{3}$ = £1858 4s. Ans.

4. Make out a bill for 18¼ yards of silk at 5s. 6d. per yard; 64 yards of sheeting at 1s. 4½d.; 4 pairs of blankets at 18s. 4d. per pair, and 3 pairs at 12s. 8d.; 26 yards of linen at 10¾d. 4 rugs at 19s. 6d. and 5 at £1 6s. 6d. each.

	£	s.	d.
18¼ yds. at 5/6	5	1	9
64 ,, at 1/4½	4	8	0
4 pr. blankets at 18/4 and 3 pr. at 12/8 per pair	5	11	4
26 yds. of linen at 10¾d....	1	3	3½
4 rugs at 19/6, and 5 at 1/6/6 each	10	10	6
	26	14	10½

5. Find the sum of $\frac{5\cdot7}{1\cdot52}$ and $\frac{\cdot0111}{\cdot74}$; and bring out the answer both as a decimal and as a vulgar fraction.

$\frac{5\cdot7}{1\cdot52} = \frac{570}{152} = \frac{15}{4}$; $\frac{\cdot0111}{\cdot74} = \frac{111}{7400} = \frac{3}{200}$

$\frac{15}{4} + \frac{3}{200} = \frac{750+3}{200} = \frac{753}{200} = 3\frac{153}{200}$

200)153·0(·765 — 1400 — 1300 — 1200 — 1000 — 1000

Vulgar fraction $3\frac{153}{200}$
Decimal fraction 3·765 } Ans.

6. A tradesman loses 9 per cent. by selling goods for £817 19s.; at what price should he have sold them to gain 10½ per cent?

£	s.		
91 : 110½ :: 817	19	: Ans.	
2	2	20	
182	221	16359	

$\frac{16359 \times 221}{182}$ = 19864 s. 6 d. = £993 4 6 Ans.

7. A bankrupt owes £1537 3s. 4d., but his estate is worth only £960 14s. 7d. What can he pay in the pound, and what does a creditor receive to whom he owes £325 10s.?

£	s.	d.	£	s.	d.	£	
As 1537	3	4 :	960	14	7 ::	1	: 1st Ans.
20			20				
30743			19214				
12			12				
368920			230575				

5

$\frac{230575 \times 1}{368920}$ = £ s. d. = 12 6 Ans. 1st.

73784 | 8

£	£	s.	s.	d.	
As 1	: 325	10 ::	12	6	: 2nd Ans.
2	2				
2	651				

6s. 3d.

$\frac{12s.\ 6d. \times 651}{2}$ = £203 8s. 9d. Ans. 2nd.

8. A train travelling 33⅓ miles per hour makes a journey in $2\frac{7}{12}$ hours. In what time would it have traversed the same distance if the speed had been at the rate of 38½ miles per hour.

hrs.

38½ : 33⅓ :: $2\frac{7}{12}$: Ans.

$\frac{2\frac{7}{12} \times 33\frac{1}{3}}{38\frac{1}{2}} = \frac{\frac{31}{12} \times \frac{100}{3}}{\frac{77}{2}} = \frac{\frac{5}{55}}{24} \times \frac{\frac{7}{168}}{5} \times \frac{2}{\frac{77}{11}}$ = 2 hours. Ans.

9. If a grocer gains one-eighth of the cost price by selling tea at 3s. per lb., how much per cent. would he gain if he sold the same at 3s. 4d. per lb.?

3s. = ⅞ of cost price, *i.e.*, cost price = ⅛ of 3s. = 2s. 8d. per lb.

3s. 4d. − 2s. 8d. = 8d. = gain on 2s. 8d.

As 2s. 8d.	: £100 ::	8d.	: Ans.
3	20		
	2000		
	3		
	6000		

$\frac{8 \times 6000}{8}$ = 6000d. = £25. 25 per cent. Ans.

10. Place within each of the brackets below the number required to complete the statement of proportion, and give the rule:—

(*a*) 64 : ( ) :: 576 : 225
(*b*) ·004 : 1·4 :: ·02 : ( )
(*c*) ( ) : 17 :: 804 : 67
(*d*) 832 : 122 :: ( ) : 2440

Rule.—The product of the means = the product of the extremes, ∴ for the required factor, divide the product of which the factors are given, by the one factor whose fellow is required.

(*a*) 25. (*b*) 7. (*c*) 204. (*d*) 16,640. Answers.

11. Two numbers together make 360, and they are to one another as 2 : 7; what are they?

1st number = $\frac{2}{2+7}$ of 360 = 80.
2nd number = 360 − 80 = 280.

12. Air is composed of 75·55 per cent. of nitrogen, 23·22 per cent. of oxygen, and 1·23 per cent. of carbonic acid. In a chamber containing 6,548 cubic feet, how much is there of each gas?

75·55 + 23·22 + 1·23 = 100

Nitrogen = $\frac{75\cdot55}{100} \times 6548 = 75\cdot55 \times 65\cdot48$ = 4947·014

Oxygen = $\frac{23\cdot22}{100} \times 6548 = 23\cdot22 \times 65\cdot48$ = 1520·4456

Carbonic acid = 6548 − (4947·014 + 1520·4456)
= 6548 − 6467·4596 = 80·5404.

13. Give the equivalents of the following decimal expressions in English money; and of the following sums of money in decimals of a pound. Work them if you can by simple inspection, and without the help of writing:—

(*a*) £16·25, £1·025. £7·16, £2,034·875.
(*b*) £2 12s. 6d.; £134 10s.; 7s. 6d.; £1 1s.

Answers: (*a*) £16 5s., £1 0s. 6d.; £7 3s. 4d.; £2,034 17s. 6d.;
(*b*) £2·625, 134·5; ·375; 1·05.

14. Say what is meant by each of the following terms, and give an example of each:—Measure, product, subtrahend, square, per centage, consols, dividend.

A *measure* of a number is a number which is contained exactly in that number.

A *product* is the result of multiplying two or more numbers together.

The *subtrahend* is the number subtracted from another number.

The *square* of a number is the product of a number when multiplied by itself.

Per centage is the rate per one hundred.

Consols is the term applied to the consolidated part of the national debt; such as the Three per Cent. Stock.

The *dividend* is the number which is to be divided by another number.

15. Show how you would explain to a class of children, by help of an example, the reason for *one* of the following processes :—

(*a*) Carrying in subtraction.

(*b*) Finding the greatest common measure.

(*c*) Dividing one fraction by another.

(*c*) Reason for dividing one fraction by another. Rule for doing this? Invert the divisor and proceed as in multiplication.

Take for example $\frac{5}{8} \div \frac{7}{16}$.

Let us first consider the 7 in the numerator of the divisor; and let us divide $\frac{5}{8}$ by 7. If I multiply the 8 by 7 I divide the unit into 7 times as many parts, and therefore one-seventh the former size. If I take 5 of these parts, I have only one-seventh of the $\frac{5}{8}$ which I had before, *i.e.*, by multiplying the 8 by 7 I divided the fraction by 7. But I had to divide by $\frac{7}{16}$; ∴ by dividing by 7 I have divided by 16 times too much. I must, therefore, multiply the last quotient by 16.

Thus $\frac{5}{8 \times 7} \times 16 = \frac{5}{8} \times \frac{16}{7}$, *i.e.*, I have practically inverted the divisor and multiplied.

Music.

TONIC SOL-FA.

1. Rewrite the following : (1) halving the value of every note and (2) again, doubling the value of every note and rest.

| m .f :s | d :— | r :- .m | d : ‖

Answer.

(1) | m,f.s : d | r .,m : d. ‖

(2) | m :f | s :—| d :—|—:—|r :—|—m | d :—| : ‖

2. Describe the intervals (major third, &c.) formed by the following pairs of notes.

‖ (1) d / m | (2) l / f | (3) ma / d ‖

Answer. (1) Minor 6th. (2) Major 3rd. (3) Minor 3rd.

3. What is the name (1) for *doh* sharp, (2) for *te* flat, (3) for *fah* sharp, (4) for *me* flat?

Answer (1) *de*, (2) *ta*, (3) *fe*, (4) *ma*.

4. Write the signs for (1) two-pulse measure, (2) four-pulse measure, (3) six-pulse measure. Make all the pulses equidistant.

(1) | : ‖ (2) | : | : ‖ (3) | : : | : : ‖

5. Write an ascending minor scale (*lah* mode) using the minor or essential sixth and the major or essential seventh.

Answer.

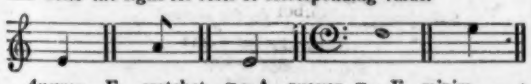
| l_1 : t_1 | d :r | m :f | se :l ‖

6. Explain the following terms.—(1) Da Capo. (2) M. 90. (3) Crescendo. (4) Legato.

Answer.—(1) Repeat from the beginning. (2) Metronome, 90 beats per minute. (3) Gradually increase in intensity. (4) Smoothly.

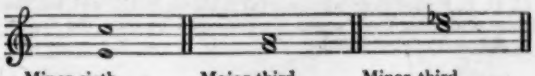
STAFF NOTATION.

1. Write the pitch names (C, B, or *Do*, *Si*, &c.) and the duration names (crotchet, minim, &c.) of the following notes, and write the signs for rests of corresponding value.



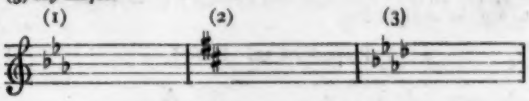
Answer.—E, crotchet, 𝄽; A, quaver, 𝄾; E, minim, 𝄼; F, semibreve, 𝄻; G, crotchet, 𝄽.

2. Describe the intervals (major third, &c.) formed by the following pairs of notes.

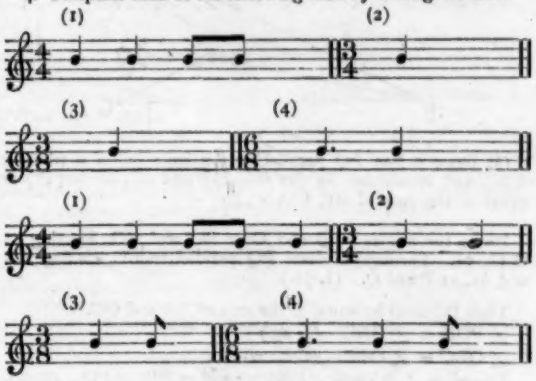


Minor sixth. Major third. Minor third.

3. Write the signature of the scale of (1) E♭ major, (2) D major, (3) A♭ major.



4. Complete each of the following bars by adding *one* note.



5. Write the ascending scale of F minor, using the major sixth and the major seventh.

6. Explain (briefly) the following terms :—(1) Da Capo. (2) ♩ = M 90. (3) Crescendo. (4) Legato.

(1) Repeat from the beginning. (2) Each crotchet is to have 1 beat and the metronome is 90 beats to the minute. (3) Increase gradually in intensity. (4) Smoothly.

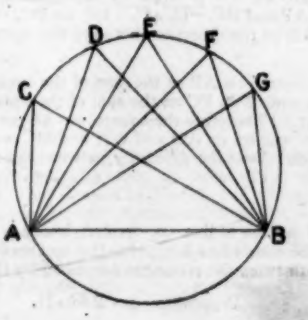
Euclid.

1. If two △s have two sides of the one equal to two sides of the other each to each, and have likewise their bases equal, the ∠ which is contained by the two sides of the one shall be equal to the angle contained by the two sides equal to them of the other.

What is the converse of this proposition? Is it universally true?

Prop. 8. Book I.

One converse is: If two triangles have their bases equal, and also the angles opposite those bases equal, the sides containing these angles shall be equal.

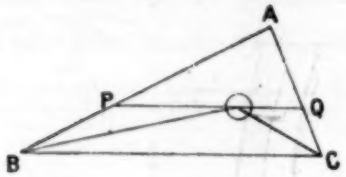


This is not universally true, for the triangles ACB, ADB, AEB, AFB, AGB, have the same base AB, and the angles at C, D, E, F, and G are all equal (as is shown in III. 21), but the sides containing those angles are not equal because the angles at A and B are not equal.

There is another converse, which is proposition 4, and that is universally true.

2. (*a*) To draw a straight line through a given point parallel to a given straight line.

Proposition 31. Book I.



(*b*) Draw a line PQ parallel to the base BC of a triangle ABC, and terminated by the sides AB and AC, so that PQ is equal to the sum of BP, CQ.

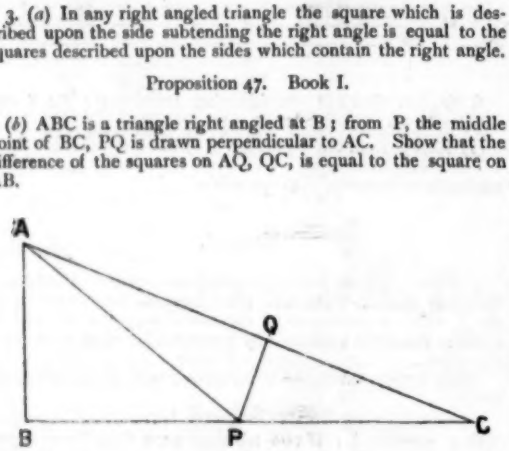
Bisect the angles at B and C by BO and CO, meeting at O (I. 9). Through O draw PQ parallel to BC, cutting AB and AC at P and Q. (I. 31.)

Then PQ shall be equal to the sum of BP and QC.
$\angle$ POB = $\angle$ OBC. (I. 29.)
$\angle$ OBC = $\angle$ OBP. (Constr.)
Therefore $\angle$ POB = $\angle$ OBP, therefore PB = PO. (I. 6.)
In the same way it may be proved that OQ = QC.
Therefore PQ = the sum of BP and QC. Q.E.F.

3. (*a*) In any right angled triangle the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Proposition 47. Book I.

(*b*) ABC is a triangle right angled at B; from P, the middle point of BC, PQ is drawn perpendicular to AC. Show that the difference of the squares on AQ, QC, is equal to the square on AB.



The square on AB is equal to the difference between the squares on AP and BP. (I. 47). BP = PC. Therefore the square on AB = the difference between the squares on AP and PC.

Now the square on AP = the sum of the squares on AQ and QP and the square on PC = the sum of the squares on QC and QP. (I. 47.) Therefore the square on AB = the difference between the squares on AQ and QP, and QC and QP, that is, the square on AB = the difference between the squares on AQ, QC. Q. E. D.

4. (*a*) If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

Proposition 4. Book II.

(*b*) What is the corresponding result in Algebra?

If $a + b$ be a line divided into two parts, a and b, then $(a + b)^2 = a^2 + b^2 + 2ab$.

Algebra.

1. Simplify
$2[3a - (4b - 5c)] - 3[4a - (5b - 2c)] + 4[5a - 3(b - c)]$.

Taking out the inner brackets this is
$2[3a - 4b + 5c] - 3[4a - 5b + 2c] + 4[5a - 3b + 3c]$
$= 6a - 8b + 10c - 12a + 15b - 6c + 20a - 12b + 12c$
$= \underline{14a - 5b + 16c}$. Ans.

2. Find the value of $\frac{7x^2 - 10xy + 3y^2}{7x^2 + 10xy + 3y^2} - \frac{20y}{33x}$, when $x = 5, y = 3$

$$\frac{7x^2 - 10xy + 3y^2}{7x^2 + 10xy + 3y^2} - \frac{20y}{33x}$$
$$= \frac{175 - 150 + 27}{175 + 150 + 27} - \frac{60}{165}$$
$$= \frac{52}{352} - \frac{4}{11} = \frac{-76}{352} = \frac{-19}{88} \text{ Ans.}$$

3. Reduce $\frac{39(x^4 - 4x^3 + 4x^2 - 1)}{65(x^4 + 4x^2 - 4x - 1)}$ to lowest terms

$$\frac{39(x^4 - 4x^3 + 4x^2 - 1)}{65(x^4 + 4x^2 - 4x - 1)} = \frac{3[x^4 - 1 - 4x^3(x - 1)]}{5[x^4 - 1 + 4x(x - 1)]}$$
$$= \frac{3[(x^2 + 1)(x^2 - 1) - 4x^2(x - 1)]}{5[(x^2 + 1)(x^2 - 1) + 4x(x - 1)]}$$
$$= \frac{3[(x^2 + 1)(x + 1)(x - 1) - 4x^2(x - 1)]}{5[(x^2 + 1)(x + 1)(x - 1) + 4x(x - 1)]}$$
$$= \frac{3[(x^2 + 1)(x + 1) - 4x^2]}{5[(x^2 + 1)(x + 1) + 4x]} \text{ or } \frac{3(x^3 - 3x^2 + x + 1)}{5(x^3 + x^2 + 5x + 1)} \text{ Ans.}$$

Simplify $\left(\frac{2x - y}{x + 2y} - \frac{2x - y}{2x + y}\right) \div \frac{x^2 + y^2}{x^2 + 2xy}$

$$= \frac{(4x^2 - y^2) - (x^2 - 4y^2)}{(x + 2y)(2x + y)} \times \frac{x(x + 2y)}{x^2 + y^2}$$
$$= \frac{3(x^2 + y^2)}{(x + 2y)(2x + y)} \times \frac{x(x + 2y)}{x^2 + y^2}$$
$$= \frac{3x}{2x + y} \text{ Ans.}$$

4. Solve the equations:—

(I.) $\frac{5x - 13}{21} - \frac{5(3 + x)}{14} = -4 - \frac{5 - x}{6}$

$$\frac{2(5x - 13) - 15(3 + x)}{42} = \frac{-168 - 35 + 7x}{42}$$
$$10x - 26 - 45 - 15x = 7x - 203$$
$$12x = 132$$
$$\underline{x = 11}. \text{ Ans.}$$

(II.) $\left.\begin{aligned} \frac{3x - 2y}{7} + \frac{2x - 3y}{5} &= 2\tfrac{1}{2} \\ 31y - 30x + 111 &= 0 \end{aligned}\right\}$

Multiplying both sides of the first by 35.

$$\left.\begin{aligned} 29x - 31y &= 98 \\ 31y - 30x &= -111 \end{aligned}\right\}$$

Adding, $-x = -13$

That is $x = 13$

Substituting value of x in the second

$$31y - 390 = -111$$
$$31y = 279$$
$$\therefore y = 9.$$
$$\left.\begin{aligned} x &= 13 \\ y &= 9 \end{aligned}\right\} \text{ Ans.}$$

5. Solve the equation

$$\frac{23}{x+4} - \frac{x+5}{3} + \frac{3x}{11} = 0.$$

Multiplying both sides by 33 $(x+4)$, the L.C.D., we get

$$759 - 11(x+4)(x+5) + 9x(x+4) = 0$$
$$759 - 11x^2 - 99x - 220 + 9x^2 + 36x = 0$$
$$2x^2 + 63x - 539 = 0$$

factorising, $(x-7)(2x+77) = 0$

$\therefore x - 7 = 0$ and $x = 7$
or $2x + 77 = 0$ and $x = 38\frac{1}{2}$ } Ans.

7. A and B have two guineas between them; and if A give to B one shilling for every penny B had, A will then have ten shillings less than B. How much had each at first?

Let x = number of shillings B had;

Then $42 - x$ = number of shillings A had, and $12x$ = number of pence B had.

Taking $12x$ shillings from $42 - x$ shillings, A has $42 - x - 12x$ shillings.

Adding $12x$ shillings to x shillings, B has $13x$ shillings.

$$42 - x - 12x = 13x - 10$$
$$26x = 52$$
$$x = 2 = \text{B's share in shillings}$$
$$42 - x = 40 = \text{A's share in shillings}$$

A £2. B 2s. Ans.

School Management.

1. Write full notes of a lesson on 'MOUNTAINS.'

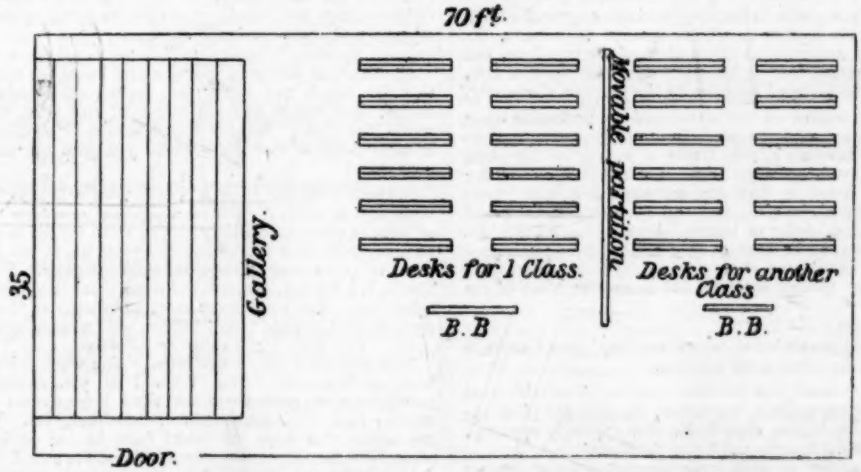
(i.) *What a mountain is.* Height over 1000 feet.

(ii.) *How caused?* Explain the gradual contraction of the earth, consequent on its cooling. Illustrate by a brass ball contracting upon cooling, being too great to pass through a ring when hot, but on getting cold, falling through. The consequence of this cooling of the earth is that the surface crumples, the raised parts being mountains.

(iii.) *How distributed over the earth.* Refer to map of the world. Let class notice how the mountains lie round the Pacific Ocean; also how they form the backbone of the continents and peninsulas. Illustrate by Europe, Italy, India, &c.

(iv.) *Uses.* *(a)* To cool the air in neighbourhood. *(b)* To condense clouds and thus cause rain, whence the rivers are supplied, and the land fertilized. *(c)* Add beauty to the landscape. *(d)* Increase the surface of the earth. *(e)* Bring the minerals of the earth's centre within easy reach of man.

2. Draw a plan of the schoolroom with which you are most familiar, showing the position and relative sizes of desks and gallery. Explain the advantages or disadvantages of the arrangement.



With reference to the desks, the *dual* desks would be an improvement on those shown above, as they facilitate the teacher's getting among the children. The gallery is best at the end of the room as above, for in singing lessons, which are generally collective, the sound is much better when the opposite wall is more distant. If one group of desks be made to back the wall opposite the gallery, the teachers of the two classes would be brought too near each other, and thus be a mutual disturbance.

3. Describe exactly what is expected of a scholar at the examination for the Fourth Standard in reading, writing, arithmetic, English, and geography. (Vide code for this.)

4. If the following sentences occurred in a reading-lesson, what words, phrases, or allusions would you think it necessary to explain, and how would you explain them:—

'It is now sixteen or seventeen years since I saw the Queen of France, then the Dauphiness, at Versailles, and surely never lighted on this orb, which she hardly seemed to touch, a more delightful vision. I saw her just above the horizon, decorating and cheering the elevated sphere she just began to move in—glittering like the morning star, full of life and splendour and joy.'

'Oh! what a revolution! and what a heart I must have to contemplate without emotion that elevation and that fall! Little did I dream, when she added titles of veneration to those of enthusiastic, distant, respectful love, that I should have lived to see such disasters fallen upon her in a nation of gallant men, in a nation of men of honour and of cavaliers.'

The Queen of France—whom here referred to? Marie Antoinette, guillotined in the great French Revolution at the end of last century.

Dauphiness—wife of the heir to the crown, who is called in France the Dauphin.

Versailles—where the court of France was held.

Never *lighted* on this *orb*, which she seemed hardly to touch. *Lighted*, a shortened form of *alighted*; *orb*, a circular body that revolves in its orbit; here the *orb* is our earth. The meaning of the passage is that her step was exceedingly light.

I saw her just above the horizon, &c. The Queen is here compared to a brilliant star rising above the horizon into a part of the heavens higher than it had held before, and which it was illuminating. By this he means that she had by marrying the Dauphin taken a more exalted position in life, and by her beauty and grace was adorning the society of which she was now the leading person.

Revolution—a turning over; a great change. Give brief account of French Revolution.

contemplate—to dwell on in thought.

emotion—strong feeling.

elevation—rising up to a higher position.

fall—the humiliation and execution of Marie and her husband.

she added titles of veneration to those of enthusiastic, distant, respectful love, &c.—*title* here means *a claim; veneration* is profound respect. The meaning of the passage is that having become Queen she had a stronger claim than before to the profound respect of her people, who had, when she was the Dauphiness, been enthusiastic in their devotion, and had loved her with an affection full of respect, and lacking that familiarity which breeds contempt.

disaster—explain its connection with old astrology—meaning some evil destiny as fixed by the star under which one was born.

a nation of gallant men—The French had always been considered the most polite and considerate to ladies, and yet they beheaded this poor lady.

cavaliers—From Lat. caballus, a horse; therefore, really a horseman. The French were always a military nation—the leading officers of which were called cavaliers.

5. Out of 30 hours in a school for older children, what time should be devoted to each employment or subject of instruction.

Religious Knowledge 2½ hours; *Reading* 10 hours; *Arithmetic* 5 hours; *Dictation and Spelling* 4 hours; *Grammar* 3½ hours; *Writing* 3 hours; *Geography* 2 hours.

Reasons.—There is no subject which so extends the general information and quickens the intelligence, as well conducted Reading lessons; in this subject History, Geography, Grammar, Science and in fact almost every subject has to be treated. A facility in reading is the best preparation and incentive to children's pursuit of learning after leaving school.

Arithmetic from its difficulty to children and splendid mental discipline must come next in order of time.

Dictation and Writing from copies on Blackboard or in Copy Books to which 7 hours is allotted are important because the career of many children depends on the style and fluency of their hand-writing, spelling, and composition. In higher classes much of this time will be given to composition.

Grammar requires from its difficulty and from the mental exercise it affords, more time than Geography.

6. Make four sums such as would be properly suited to a scholar in the 5th Standard, and give a few examples also of the sort of questions in Mental Arithmetic such a scholar should be able to answer.

(*a*) Find the value of 2 qrs. 4 lbs. 6 oz. 12 drams at £1 13s. 6d. per lb.

(*b*) Make out a bill for the following:—4 yds. at 12s. 6d. per yd.; 64½ yds. at 3s. 7d. a yard; 5 doz. at 3½ per doz.; 45 pairs at 3s. 6d. a pair.

(*c*) If 48 horses eat 18 bushels in a week how many bushels will 30 horses eat?

(*d*) $\frac{5}{8} + \frac{3}{32} + \frac{3}{4} + \frac{1}{8} - \frac{3}{32}$.

144 at 8½d.; 240 at 7½d.; 960 at 11¼d.; 258 at 3s. 4d.; 471 at 2s. 6d.; L.C.M. of 8, 4, 12; G.C.M. of 16, 120.

If 18 articles cost 4s. 6d. how much would 10 cost?

Difference between ⅓ and ¼. Sum of ⅓ and ¼.

7. Describe the sort of apparatus and visible illustration which are likely to prove most helpful to a teacher in giving the earliest lessons in Geography.

A globe, a map, a board with different coloured sands and chalks, whereby the teacher can illustrate the landscape, the sea, capes, rivers, mountains, &c., and then point to the map and show how they are represented there. Pictures in the shapes of bird's-eye views are useful; as also are maps which by different shades represent different elevations.

8. Which do you prefer in teaching writing—engraved copies, or copies set by the teacher on a black board? Give reasons for your preference, and write as illustrations of the true forms and proportions of letters, four capital letters and four small letters, such as should be grouped together for the purpose of teaching.

Copies set by teacher on the blackboard are preferable when the teacher can set a good copy. In cases where the teachers are young, and have not acquired ease in writing on the black board, the engraved copies are best. The advantage of setting copies on the board is that you can thus deal with errors common to many of the class, and call the attention to special points, such as the joining of letters, where to begin them, &c. Besides, the class can be kept as long as desirable practising a difficulty, while in the case of copy books the child passes on to fill up his book, though anything but perfect in some of the exercises.

9. Give some examples of 'word building' as an exercise in English, and say what is the use of it.

Take the Latin word *pono* (positus), I place. From this word we get *post*, impost, posture, imposture; we also get pose, impose, imposing, superpose, expose, dispose, opposite, apposite, apposition, disposition, indisposition, exposition.

The Latin supplies us with *capio* (captus), whence we get our word *ceive*, seen in re*ceive*, deceive, conceive, conceivable, inconceivable, receptacle, receptive, deceptive, acceptable. The use of this exercise is to teach childen the real meaning of the word, and to see that words are not merely arbitrary sounds. They will also be helped in selecting the right word at times.

This exercise will often prevent such spelling as *oposite*, *disatisfy*, &c., the children having learnt by word-building that the prefix is dis, and the root satis.

10. The Code requires that 'appropriate occupations' shall be provided for children in an infant school, besides instruction in reading, writing, and arithmetic, and in common objects. What are the best of these 'occupations,' and what educative purpose do they serve?

The Kindergarten gifts form the most suitable of these occupations.

Paper-folding cultivates accuracy and neatness in the children, and at the same time teaches them the common straight lined forms. While the eye is thus trained, and the mind exercised, the fingers are made dexterous and supple.

Gift IV., 'The bricks,' forms a fund of amusement and practice of ingenuity to the children.

The use of slates ruled in squares like the teacher's black board, trains the children in designing.

Constructions with *peas* and *sticks*, and clay modelling, which are more difficult, may with advantage be used with the elder children in the Infant schools.

These gifts, like all Froebel's teaching, tend to train the hand at the same time as the eye and intellect are trained. Besides this the attention of the children is easily fixed when they are themselves engaged in work.

11. What sort of sketch should appear on the black-board at the end of a collective lesson on 'The Ocean.'

I. *Subdivisions.*—Pacific, Atlantic, Indian, Arctic, Antarctic.

II. *Character of Coast lines* of those subdivisions.

III. *Chief Currents.—Cause:* Unequal distribution of heat. *Uses:* Modifying temperature and aiding commerce.

IV. *Prevailing Winds. — Cause:* Unequal temperature of different parts of globe. *Uses:* Modifying temperature and aiding commerce.

V. *Uses.*—(*a*) Climatic, (*b*) Commercial, (*c*) Sanitary, (*d*) Food-supplying, (*e*) The water reservoirs of the world.

This sketch constitutes the framework of the lesson. It should be copied down by the children, who by its aid should, as an exercise in composition, reproduce the lesson.

12. What rules should be adopted by a teacher in order to keep the school-room perfectly healthy and clean?

In addition to seeing that the room is *scrubbed fortnightly, swept and dusted each day, the windows cleaned regularly*, and the *walls and rafters brushed at frequent intervals*, the teacher should appoint a monitor each week to clear out and dust cupboards, and remove and destroy all lumber and litter. The windows should be opened during play-time, so as to thoroughly purify the air. When the classes are changing, or the children being exercised, the windows can be opened for a few minutes. The childrens' hats and cloaks must not be hung up in the room where the children are taught.

13. Suppose you were giving a first lesson on the adjective to a class which had just passed the Second Standard examination, how would you set about it, and what illustrations would you give? What is your definition of an adjective, and at what point in your lesson would you give the definition to your class?

Suppose I tell you I saw a 'boy.' You will probably ask me what sort of a boy? Was he a big boy, or a little boy, a fat, or thin, or good, or bad boy? The word *boy* did not give you an idea quite clear enough, so you want me to use some other word to make your knowledge more complete. When I tell you he is a *big* boy, which is the word that adds to your knowledge and gives you a more exact knowledge of the boy, and does not let the word 'boy' have so wide a meaning?

big. This word big is called an adjective.

Next suppose I say 'I saw boys.' You want to know which boys, or how many boys. When I tell you *several* boys, or *twenty* boys or, *those* boys, the word boys cannot mean any number from two to any number however great. Which are the words that keep the word from having so indefinite a meaning? *Several, twenty, those.* These are called Adjectives.

What then are adjectives?

Adjectives are words placed by the side of nouns in order to modify or limit their meaning?

The word adjective means 'lying by the side of.'

14. What is the use of 'learning by heart'? Name some things which ought, and others which ought not, to be learned by heart; and give your reasons.

Use—Exercises the memory, and thus strengthens it.

Things which ought to be learnt by heart.—Good poetry and prose as the passages will supply those who learn them with ideas and suitable quotations. Their own expression will be assisted and their command of words improved and extended.

Accuracy will be required, and thus the habit cultivated.

Definitions and Tables are well learnt by heart, as are also *lists of exceptions* where there is no logical connection to enable one to remember them easily, or where readiness is absolutely necessary.

Things which ought not to be learnt by heart. Geometrical problems, lists of capes, bays, &c. (except where the learner can see in his mind's eye the relative position of each one), the facts of history (of course dates must be learnt by heart). The problems and these historical events are able to be remembered by reason of their logical connection which what precedes; consequently, if they are learnt by heart, we neglect the use of our higher faculties and do that which a parrot might do.

Of course 'learning by heart' is more quickly done and what is learnt is better remembered where the reason is employed in fixing the thing learnt in the memory.

15. Show how you would explain to a class of beginners the reason of 'Subtraction of Fractions.'

Suppose there are 6 oranges and nothing else on the table, can I take 3 apples from those 6 oranges? No; of course I can't take apples when there are only oranges. Again, suppose you have 18 pennies on the table, can I take 4 halfpennies from them? No, but I can take 2 pennies, which equal in value 4 halfpennies.

It is just the same with fractions:—

Take an example: $\frac{3}{5} - \frac{4}{7}$.

$\frac{4}{7}$ taken away from $\frac{3}{5}$ is neither so many fifths nor so many sevenths; before I can perform this subtraction I must reduce them to the same denomination. L. C. D. = 35.

$\frac{3}{5} = \frac{21}{35}$ $\frac{4}{7} = \frac{20}{35}$

$\frac{21}{35} - \frac{20}{35} = \frac{1}{35}$

Now that $\frac{3}{5}$ is changed into its equivalent. viz., $\frac{21}{35}$
and $\frac{4}{7}$ " " " " $\frac{20}{35}$
I can easily subtract them, and of course shall have $\frac{1}{35}$ left.

16. How far is it in the power of a teacher, by other means than school lessons, to improve the habits, manners, and character of the children of a school? Mention any ways you know by which a teacher may exert useful influence in these respects.

I. *By the personal example of the teacher:* If the teacher is courteous, polite, gentle, truthful, generous, &c., these virtues will be unconsciously imitated and finally imbibed by the children.

II. By the encouragement of these virtues in the scholars; the suppression of violence, and bullying; oversight in the playground; seeing that there is no unfair play, nor tyranny of the strong over the weak.

The more the teacher is beloved and admired the more is he the pattern which his scholars try to imitate.

History.

1. Say who was reigning in England at the beginning of each of the ten centuries from the tenth to the nineteenth inclusive, and give in each case the date of the sovereign's accession and death.

Century.	Name of King	Date of Accession.	Date of Death.
10	Alfred	871	901
11	Ethelred II.	978	1013
12	Henry I.	1100	1135
13	John	1199	1216
14	Edward I.	1272	1307
15	Henry IV.	1399	1413
16	Henry VII.	1485	1509
17	Elizabeth	1558	1603
18	William III.	1689	1702
19	George III.	1760	1820

2. What is meant by a Minister of State, a Spiritual Peer, Knight of the Shire, a Lord Chancellor, a Chief Justice, an Admiral, a Field Marshal, a Regent, a Governor General? Name some eminent persons who have filled any of these offices and say when they lived.

(*a*) A Minister of State is a person who is intrusted with the management of State affairs. Lord Burleigh, Elizabeth's reign.

(*b*) A Spiritual Peer is an Archbishop or Bishop of the Church of England who sits in the Upper House. Archbishop Cranmer, Edward VI.'s and Mary's reign.

(*c*) A Knight of the Shire is the old name for a member of parliament who represented counties. He must possess £600 per annum in freehold estate. Lord Beaconsfield, present reign.

(*d*) A Lord Chancellor is the keeper of the Great Seal, the highest officer of the crown, and the second of the nine persons who necessarily form the cabinet. Francis Bacon, James I.'s reign.

(*e*) A Chief Justice is the highest judge of the realm. Coke, James I.'s reign.

(*f*) An Admiral is a naval officer of the highest rank. Nelson, 1758—1805.

(*g*) A Field Marshal is an officer of the highest rank in the army. Wellington, early in present century.

(*h*) A Regent is one who rules for the sovereign, being intrusted with interim sovereign authority.
Richard, Earl of Gloucester, afterwards Richard III., 15th century.

(*i*) A Governor-General is the commander of an army in service. Lord Cornwallis, 1786.

3. Recount the chief incidents in the reign of Elizabeth.

1559. Protestant Religion re-established by Parliament. Acts of Supremacy and Uniformity passed.
1562. Ratification of the 39 articles.
1568. Mary Stewart flees to England.
1572 Massacre of Protestants in France on St. Bartholomew's day.
1577—80. Drake's voyage round the world.
1586. Sir Philip Sydney mortally wounded at Zutphen.
1587. Execution of Mary Queen of Scots at Fotheringay.
1588. Defeat of the Spanish Armada.
1600. Establishment of East India Company.
1601. Poor Law passed.
Commencement of the maritime greatness of England in this reign.

4. What is meant by civil war? Say when there have been civil wars in England and give details respecting their origin, the chief engagements which took place in connection with them, and their final results.

By civil war is meant war in which the opposing parties are of the same nationality.

(1) War of the Roses, 1455 to 1485.

(*a*) Origin.—The rivalry between the Lancastrians and the Yorkists, descendants respectively of John of Gaunt, Duke of Lancaster, and Edmund, Duke of York, sons of Edward III.

(*b*) Chief engagements.

Battle.	Date.	Victorious Party.
St. Albans, 1st. ...	1455 ...	Yorkists
Blorcheath	1459 ...	"
Northampton	1460 ...	"
Wakefield	" ...	Lancastrians.
Mortimer's Cross .	1461 ...	Yorkists.
St. Albans, 2nd...	" ...	Lancastrians.
Towton	" ...	Yorkists.
Hedgeley Moor...	1464 ...	"
Hexham	" ...	"
Barnet	1471 ...	"
Tewkesbury	" ...	"
Bosworth	1485 ...	Lancastrians.

(*c*) Final results. Lancastrians victorious. Richard III., of the House of York, killed at Bosworth. Henry VII., of the House of Lancaster, ascended the throne.

(2.) The Great Rebellion, 1642—1649.

(*a*.) Origin. The arbitrary power of king, and consequent disputes between the king and parliament. Immediate cause, Charles' attempt to seize five members of the House.

(*b*.) Chief engagements.

BATTLE.	DATE.	VICTORIOUS PARTY.
Edgehill	1642 ...	Doubtful
Chalgrove Field	1643 ...	Royalists
Lansdown.....	,, ...	,,
Roundway Down.....	,, ...	,,
Atherton Moor.....	,, ...	,,
Newbury (1st)	,, ...	Doubtful
Copredy Bridge	1644 ...	Royalists
Marston Moor	,, ...	Parliament
Newbury (2nd).....	,, ...	Doubtful
Naseby	1645 ...	Parliament

(*c*.) Final results. Charles brought to trial, and condemned as a tyrant, traitor, murderer, and public enemy.

5. Give a short account of any three of these :—Magna Charta, the Reformation, the Great Rebellion, Catholic Emancipation, the Reform Bill, and the Repeal of the Corn Laws.

(1.) *Magna Charta*, 1215. The barons, wearied out by the tyranny and abominable conduct of John, determined that they would extort from him a charter securing their liberties. As he would not comply with their demand they took up arms, and he was forced to submit. The charter is known as Magna Charter (Great Charter). It was signed at Runnymede on June 19. The most important of the 63 clauses were (*a*) no scutage or aid to be imposed but by the Common Council of the kingdom. (*b*) A freeman not to be deprived of anything necessary to his subsistence. (*c*) No freeman to be imprisoned, or deprived of his property, except by the legal judgment of his peers, or the law of the land. (*d*) Justice not to be sold, delayed, or denied to any. This charter was really a treaty of peace between the king and the people.

(2.) *The Reform Bill*, 1832.—The question of reform had long been agitated. In 1831 Lord John Russell introduced a Reform Bill, which was rejected. It, however, passed through both Houses the following year. By this Act (*a*) many small places were disfranchised, (*b*) others were empowered to return members, and (*c*) the franchise was largely extended.

(3.) *Repeal of the Corn Laws*, 1846.—A powerful league formed by Mr. Cobden, called the 'Anti-Corn Law League," had been in existence for many years, and mainly through its exertions a strong feeling against a tax upon corn had been created throughout the country. Sir Robert Peel had hitherto been a supporter of the Corn Laws, but convinced by the arguments of the free-traders, he in 1846 introduced a measure for their abolition, which, after much opposition, became law.

6. Select three of the undermentioned persons, and say when they lived and for what they were severally remarkable: Dunstan, Becket, Chaucer, John of Gaunt, Cecil, Milton, the elder Pitt, Nelson, and Macaulay.

(*a*) *Becket.*—A powerful Churchman who lived during the reign of Henry II. He was made Archbishop of Canterbury in 1162, but soon after quarrelled with the king. The cause of the quarrel was Becket's refusal to allow the clergy to submit to the civil courts. Henry triumphed at the Council of Clarendon in 1164; but the prelate afterwards set at naught the 'Constitutions' then passed. A hasty expression of the king suggested to some of his knights that he wished to get rid of Becket by violence; and they murdered him in the Cathedral of Canterbury in 1170.

(*b*) *Milton.*—A poet, born 1608, died 1674. He spent his early life in study, in travel, in writing poetry, and in teaching. When the dispute arose between King and Parliament, he wrote pamphlets on the popular side. He was appointed Foreign Secretary to the Commonwealth in 1649. In 1654 he lost his eyesight. After the Restoration he retired into obscurity and wrote his great poems, 'Paradise Lost,' and 'Paradise Regained.'

(*c*) *Nelson.*—England's greatest sailor. Born 1758, died 1805. When only 15 he joined an expedition sent out to search for a North-West Passage. When the French war broke out Nelson sailed to the Mediterranean as commander of the Agamemnon. He was appointed commodore, and helped to shatter the navies of France and her allies at St. Vincent (1797), the Nile (1798), Copenhagen (1801), and Trafalgar (1805), where he was killed.

7. What memorable events have happened at any three of the following places:—Naseby, Stamford Bridge, Hastings, The Nore, The Boyne, Torquay, Evasham, Cressy, Edinburgh, Blenheim, and Cape La Hogue.

(*a*) Blenheim.—Battle 1704. Marlborough and Prince Eugene gained a splendid victory over French and Bavarians.

(*b*) Boyne.—Battle, 1690. William III. defeated James, the deposed king.

(*c*) La Hogue.—Battle, 1692. French fleet defeated by the English and Dutch fleets.

8. Explain by what right and in what circumstances these sovereigns succeeded to the throne: Henry IV., Stephen, Henry VII., William III., and George I.

(*a*) *Henry IV.*—Eldest son of John of Gaunt, Duke of Lancaster, who was the fourth son of Edward III. His title to the throne was parliamentary only, as there were other members of an older branch living. Next in order of succession was Roger Mortimer, grandson of Lionel, Duke of Clarence, third son of Edward III.

(*b*) *Stephen.*—He was a usurper, Maud, daughter of Henry I., being the rightful heir. He was the grandson of William I., his mother being Adela, the Conqueror's daughter.

(*c*) *Henry VII.*—His claim was not good, but made so by Parliament. His chief claim was by right of conquest. He was a descendant of John of Gaunt, fourth son of Edward III. Even if John of Gaunt had had any claim to the crown, Henry had none, since the offspring of John of Gaunt, by Catherine Swynford, had been excluded from the succession.

(*d*) *William III.*—By the expressed wish and sanction of Parliament, he being a Protestant.

(*e*) *George I.*—By reason of the Act of Settlement passed in 1701, he being the son of Sophia of Brunswick, and a Protestant.

9. Compare the English people of the seventeenth with those of the nineteenth in regard to (1) their dwellings, (2) their employments, and (3) their means of locomotion.

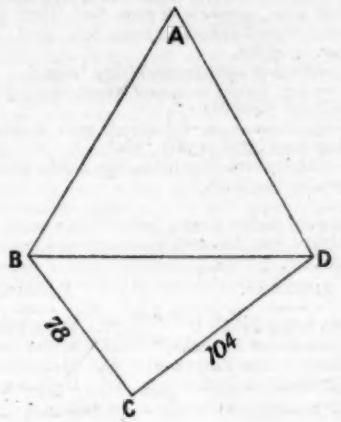
(1) *Dwellings.*—At the commencement of the 17th century the houses were mud-walled and thatched. In 1605 a proclamation was sent out, ordering that all houses within the city walls should be built of brick and stone. This regulation fell into neglect, and it was not till after the great fire of 1666 that that the erection of timber houses in the metropolis ceased. This change was enforced by Parliament. In the nineteenth century the houses are much improved. The majority are built of brick, though stone is frequently introduced. They have undergone changes in ventilation and sewerage, thus abating the virulence of infectious diseases; gas has been introduced, and many other improvements carried out.

(2) *Employments.*—People were then engaged in manufacture, mining, and agriculture. The chief branch of home industry was the woollen manufacture: the cotton manufacture was then in its infancy: silk was manufactured at Spitalfields, and linen for domestic purposes in the homes. The hardware manufacture of Birmingham and Sheffield was in an imperfect condition. Mining was carried on in different parts of the country for iron, in Cornwall for tin, in the North for coal and lead. Four-fifths of the labouring classes were engaged in agriculture. Children were employed in factories to an extraordinary extent. The cotton manufacture has made wonderful progress, four hundred times as much raw cotton being imported now as then. Notwithstanding this, the woollen manufacture has also steadily increased. In fact, all the manufactures have increased in importance and value. Many are still engaged in agriculture and mining; others in shipping and commerce.

(3) *Means of Locomotion.*—There was then comparatively little communication between different parts of the country, for there was not one navigable canal, and the high roads were in a most defective condition, and hence few took a long journey except as a matter of necessity. In some parts of the country wheeled carriages were generally drawn by oxen. Now we have railways for the transmission of passengers and goods, canals in many parts of the country, good roads for vehicular traffic.

Mensuration.

1. Two adjacent sides of a field are at right angles, and their lengths are 78 and 104 yards respectively. The other two sides form with a diagonal an equilateral triangle. Find the area of the field to three places of decimals.



$ABCD = ABD + BCD$

$ABD = BD^2 \times \frac{\sqrt{3}}{4}$

$BCD = \frac{1}{2}(BC \times CD)$

$BD^2 = BC^2 + CD^2 = 16900$

$\therefore ABD = 16900 \times \frac{1{\cdot}73201}{4} = 7317{\cdot}869$

$\frac{1}{2}(BC \times CD) = \frac{1}{2} \times 8112 = 4056$

Total area $= 11373{\cdot}869$ sq. yds. Ans.

2. The length of each side of a square piece of thin metal is four feet, and lines are drawn parallel to each side dividing it into 9 equal squares, out of each of which the inscribed circle is punched. If the value of the whole piece of metal be £14, what is the value of the circular discs thus punched out?

The diameter of each circle is $\frac{1}{3}$ of 4 feet, and the radius $\frac{2}{3}$ ft. Area $= \pi r^2$; of the 9 circles the area is $9\pi r^2$.

$$= \frac{11}{7} \times \frac{2}{3} \times \frac{2}{3} \times \frac{9}{1} = \frac{88}{7} \text{ square feet.}$$

Area of square $= 16$ sq. ft.

$$\frac{\text{Area of circles}}{\text{Area of square}} = \frac{88}{7} \times \frac{1}{16} = \frac{11}{14}$$

$\frac{11}{14}$ of £14 $=$ £11. Ans.

French.

Translate into English:—

1. Je me lève de bonne heure, et je fais une longue promenade, sous les verts rameaux, avant de commencer ma tâche d'instituteur, les promenades matinales, en été, dans cette féconde région, m'offrent, à chaque pas, un nouveau sujet d'observations. Ici, un jour nuageux est une chose rare. Deux heures après qu'il a surgi à l'horizon, le soleil est déjà très ardent; mais quel plaisir alors de respirer la fraîcheur des bois et les exhalaisons de la rosée! Un grand nombre d'oiseaux, qui, dans la journée, se tiennent cachés sous l'épais feuillage des pins, immobiles, et silencieux, fatigués par la chaleur sautillent en ce moment de-ci de-là, en chantant gaiement.

1. I rise early and take a long walk under the green branches before beginning my task of teaching.

These early summer walks in this fertile region, offer to me, at every step, some new subject for observation,

Here a cloudy day is a rare occurrence. Two hours after it has risen above the horizon, the sun is already very warm; but how great a delight it is then to inhale the freshness of the trees and the scent of the dew! A crowd of birds which all day long remain hidden under the thick foliage of the firs, still and songless, wearied by the heat, then hop hither and thither, singing gaily.

2. Parse the words *je me lève, cette, qu'il a surgi, se tiennent, chantant.*

Je—pers. pro., com. gen., 1st pers. sing., nom. to *lève.*
me—pers. pro., com gen., 1st pers. sing., obj. by *lève.*
lève—reg. act. verb., indic, mood, 1st pers., sing. num., pres. indef. tense, agr. with *je.*
Je me lève—reflexive form.
cette—demon. adj., fem. gen., 3rd pers. sing., determining and agreeing with *région.*
qu' (que)—conjunction joining *Deux heures après* and *Il a surgi.*
Il—pers. pro., mas. gen., 3rd pers. sing., agr. with *soleil*, nom to *a surgi.*
a—auxiliary of tense to *surgi*, helping to form the past indef. tense.
surgi—past part. of *surgir.*
a surgi—reg. and intrans. verb, indic. mood, past indef. tense, 3rd pers. sing., agr. with *il.*
se—reflexive pro., com. gen., 3rd pers. plu., agr. with *oiseaux*, obj. by *tiennent.*
tiennent—irreg. trans. verb, indic. mood, pres. indef. tense, 3rd pers. plu., agr. with *oiseaux.*
se tiennent—reflexive form.
chantant—pres. participle (or rather gerund) of reg. trans. verb *chanter*, preceded by *en.*

3. Write out the present indicative of *punir*, the imperfect subjunctive of *recevoir.*

The pluperfect of *rompre*, the present subjunctive of *vouloir.*

Prt. indic. of *punir*: Je punis, tu punis, il punit, nous punissons, vous punissez, ils punissent.

Imp. subj. of *recevoir*: Que je reçusse, reçusses, reçût, reçussions, reçussiez, reçussent.

Pluperfect of *rompre*: J' avais rompu, tu avais rompu, &c.

Pres. subj. of *vouloir*: Que je veuille, veuilles, veuille, veuillons, veuillez, veuillent.

4. Give the present and past participles, and the first person singular of the present tense indicative, of *courir, tenir, savoir, paître, connaître, coudre, moudre, taire.*

VERB.	PRT. PART.	PAST PART.	1ST PERS. SING. PRT. INDIC.
Courir	Courant	Couru	Je cours.
Tenir	Tenant	Tenu	Je tiens.
Savoir	Sachant	Su	Je sais.
Battre	Battant	Battu	Je Bats.
Connaître	Connaissant	Connu	Je connais.
Coudre	Cousant	Cousu	Je couds.
Moudre	Moulant	Moulu	Je mouds.
Taire	Taisant	Tû	Je tais.

Latin.

1. Translate into English:—

Hæc est societas, in qua omnia insunt, quæ putant homines expetenda, honestas, gloria, tranquillitas animi, ut, quum hæc adsint, beata vita sit, et sine his esse non possit. Quod quum optimum maximumque sit, si id volumus obtinere, virtus colenda est, sine qua neque amicitiam neque ullam rem dignam consequi possumus. Ea vero neglecta, qui se amicos habere putant, tum se denique errasse sentiunt quum eos gravis aliquis casus experiri cogit. Itaque, quum judicaveris, diligere oportet; non, quum dilexeris, judicare. Sed quum multis in rebus negligentia plectimur, tum maxime in amicis diligendis. Una est amicitia in rebus humanis, de cujus utilitate omnes uno ore consentiunt quamquam a multis ipsa virtus contemnitur.

This is the companionship in which are present all those things which men think worth seeking,—honour, fame, peace of mind,—since when these things are present, life is happy, and without them it cannot be so. And since this is a very good and great object, if we wish to acquire it, we must cultivate virtue, without which we can acquire neither friendship nor any

worthy object. If indeed that is neglected, those who think they possess friends, find at length that they have deceived themselves when some serious mishap compels them to try (their friends). Therefore, when you have made your choice, it behoves you to esteem highly; not when you have fixed your affections to begin to think whether your choice is a wise one. But just as by negligence we are entangled in many affairs, so are we exceedingly so in the love of our friends. Friendship is the one thing in human affairs concerning the utility of which all unanimously agree, although virtue itself is despised by many.

2. *neglecta*—fem., sing., ablative of partic. neglectus, from negligo, neglexi, neglectum, abl., absol., agree, with *Ea.*
oportet—3rd pers., sing., pres., indic., of impers. verb oportet.
diligendis—ablative plural of gerundive diligendus, from diligo, dilexi, dilectum, diligere, agree. with amicis.
ore—abl., sing., of os-oris, abl. of instrument.

3.

N.V.	iste miles	una facies	audaces latrones
A.	istum militem	unam faciem	,, ,,
G.	istius militis	unius faciei	audacium latronum
D.	isti militi	uni faciei	audacibus latronibus
A.	isto milite	una facie	,, ,,

4. *Perfect Indicative*—

dedi	adfui	secutus sum
dedisti	adfuisti	secutus es
dedit	adfuit	secutus est
dedimus	adfuimus	secuti sumus
dedistis	adfuistis	secuti estis
dederunt	adfuerunt	secuti sunt

Pluperfect Subjunctive—

dedissem	adfuissem	secutus essem
dedisses	adfuisses	secutus esses
dedisset	adfuisset	secutus esset
dedissemus	adfuissemus	secuti essemus
dedissetis	adfuissetis	secuti essetis
dedissent	adfuissent	secuti essent

5.

POSITIVE.	COMPARATIVE.	SUPERLATIVE.
bonus	melior	optimus
maleficus	maleficentior	maleficentissimus
audax	audacior	audacissimus
gracilis	gracilior	gracillimus
malus	pejor	pessimus
inferus	inferior	infimus

German.

(German words must be written in the English character.)

1. Translate into English—

Die kleine Gänseblume war so glücklich, als ob es ein groszer Fesitag wäre, und es war doch ein Montag. Alle Kinder waren in der Schule; während die auf ihren Bänken saszen und etwas lernten, sasz sie auf ihrem kleinen, grünen Stengel und lernte auch von der warmen Sonne und Allem rings umher, wie gut Gott ist; und es gefiel ihr recht, dasz die kleine Lerche Alles, was sie in der Stille fühlte, so deutlich und schön sang. Und die Gänseblume blickte mit einer Art Ehrfurcht zu dem glücklichen Vogel, der singen und fliegen konnte, empor, war aber gar nicht betrübt, dasz sie es selbst nicht konnte. 'Ich sehe und höre ja!' dachte sie; 'die Sonne bescheint mich und der Wind küszt mich! O, wie reich bin ich doch begabt worden!'

Gänseblume, daisy.

The little daisy was as happy as if it were a great feast day (holiday), and it was only Monday. All the children were in school; while they sat upon their forms and learnt something, it (the daisy) sat upon its little green stalk and learnt also, from the warm sun and from everything round about, how good God is; and it was very pleased that the little lark sang so distinctly and beautifully about everything that it (the daisy) secretly felt. And the little daisy looked with a sort of veneration to the happy bird which could sing and fly upwards, but it was not at all sad that it could not do so itself. 'I see and hear,' it thought, 'the sun shines on me and the wind kisses me. Oh, how richly have I been endowed!'

2. Parse fully wäre, sassen, gefiel, ihr, schön, konnte, höre, mich.

wäre—irreg. intrans. verb, subj. mood, past tense, 3rd pers., sing. num., agrees with nom. 'es.' (verb sein = to be).
sassen—irreg. intrans. verb, ind. mood, past tense, 3rd pers., plur. num. agrees with nom. 'die.' (verb sitzen).
gefiel—irreg. trans. verb, indic. mood, past tense, 3rd pers., sing. num., agrees with nom. 'es' (verb gefallen).
ihr—3rd personal pro., sing. num., fem. gend., dative case, gov. by gefiel.
schön—adverb of manner modifying 'sang.'
konnte—irreg. modal verb, past tense, sing., 3rd, agreeing with der (können).
höre—reg. trans. verb, ind. mood, pres. tense, 1st pers., sing. num., agrees with 'ich.'
mich—1st pers. pro., sing. num., fem. gend., accusative case, gov. by bescheint.

3. Decline ein heller Funke, guter Wein; write in German the seventeenth, two hundred and sixty-nine, compare hoch, viel, schlecht.

	SINGULAR.	PLURAL.
N.	Ein heller Funke	Helle Funken
G.	Eines hellen Funkens	Heller Funken
D.	Einem hellen Funken	Hellen Funken
Ac.	Einen hellen Funken	Helle Funken

	SINGULAR.	PLURAL.
N.	Guter Wein	Gute Weine
G.	Guten Weines	Guter Weine
D.	Gutem Weine	Guten Weinen
Ac.	Guten Wein	Gute Weine.

Der siebzehnte, zwei-hundert neun und sechzig.
hoch—höher—der höchste or am höchsten.
viel—mehr—der meiste or am meisten.
schlecht—schlechter—der schlechteste or am schlechtesten.

4. Give the present (2nd pers. sing.), imperfect (1st pers. sing.), and the past participle of biegen, fechten, gleichen, scheiden, singen, tragen, essen.

VERB	PRESENT 2ND PERS. SING.	IMPERFECT 1ST PERS. SING.	PAST PARTICIPLE.
biegen	Du biegst	Ich bog	gebogen
fechten	Du fichst	Ich focht	gefochten
gleichen	Du gleichst	Ich glich	geglichen
scheiden	Du scheidest	Ich schied	geschieden
singen	Du singst	Ich sang	gesungen
tragen	Du trägst	Ich trug	getragen
essen	Du issest	Ich ass	gegessen

Greek.

1. Translate into English:—

Δοκῶν γὰρ θάτερόν ἐστι τὸ τεθνάναι· ἢ γὰρ οἷον μηδὲν εἶναι μηδ' αἴσθησιν μηδεμίαν μηδενὸς ἔχειν τὸν τεθνεῶτα, ἢ κατὰ τὰ λεγόμενα μεταβολή τις τυγχάνει οὖσα καὶ μετοίκησις τῇ ψυχῇ τοῦ τόπου τοῦ ἐνθένδε εἰς ἄλλον τόπον. καὶ εἴτε δὴ μηδεμία αἴσθησίς ἐστιν, ἀλλ' οἷον ὕπνος, ἐπειδάν τις, κἄθεύδων μηδ' ὄναρ μηδὲν ὁρᾷ, θαυμάσιον κέρδος ἂν εἴη ὁ θάνατος, ἐγὼ γὰρ ἂν οἶμαι, εἴ τινα ἐκλεξάμενον δέοι ταύτην τὴν νύκτα, ἐν ᾗ οὕτω κατέδαρθεν, ὥστε μηδ' ὄναρ ἰδεῖν, καὶ τὰς ἄλλας νύκτας τε καὶ ἡμέρας τὰς τοῦ βίου τοῦ ἑαυτοῦ ἀντιπαραθέντα ταύτῃ τῇ νυκτὶ δέοι σκεψάμενον εἰπεῖν, πόσας ἄμεινον καὶ ἥδιον ἡμέρας καὶ νύκτας ταύτης τῆς νυκτὸς βεβίωκεν ἐν τῷ ἑαυτοῦ βίῳ, οἶμαι ἂν μὴ ὅτι ἰδιώτην τινά, ἀλλὰ τὸν μέγαν βασιλέα εὐαριθμήτους ἂν εὑρεῖν αὐτὸν ταύτας πρὸς τὰς ἄλλας ἡμέρας καὶ νύκτας. εἰ οὖν τοιοῦτον ὁ θάνατός ἐστι, κέρδος ἔγωγε λέγω· καὶ γὰρ οὐδὲν πλείων ὁ πᾶς χρόνος φαίνεται οὕτω δὴ εἶναι ἢ μία νύξ.

2. Parse fully τεθνάναι, δέοι, ἄμεινον, εὑρεῖν.

3. Give the nominative and dative plural of θάνατος, τιμή, φύλαξ, σῶμα, βασιλεύς, ἀνήρ.

4. Write out the aorists of φεύγω, ποιέω, πείθω, λείπω, λύω, λαμβάνω.

5. Write out the comparative and superlative degrees of κοῦφος, σαφής, μέγας, κακός, and μικρός.

(1) Now the other of the two is to die! For either he that is dead has no existence at all or has no perception of anything at all, or as we said just now, there takes place some change, and a change of abode on the part of the spirit from its place here to another place. And if indeed there is no consciousness, but it is as it were a sleep in which a person sleeping sees no vision, then death is a wonderful gain; for I should think that if one were to ask a person who had selected a night on which he had thus slept so soundly as not to see a vision, to say, after having compared and examined that night with the other days and nights of his life, how many days of his life he had lived more profitably and pleasantly, I should think that not only a private person but even a mighty king would find those few moments preferable to his other days and nights. If then death is of such a nature as this, I venture to call it a gain; for indeed all time seems, thus, nothing more than one night.

(2) τεθνάναι. Perfect infinitive of θνησκω.
δέοι Opt., 3rd singular, act. of δεω.
ἄμεινον. Neuter adjective, irregular, comparative, of αγαθος. Used adverbially.
εὑρεῖν. Aorist 2, infinitive of ευρίσκω.

(3) *Nominative Plural.*—θάνατοι, τιμαί, φύλακες, σώματα, βασιλεῖς, ἄνδρες.

Dative Plural.—θάνατοις, τιμαῖς, φύλαξι, σώμασι, βασιλεῦσι, ἀνδράσι.

(4)

Aor. 1, Act.	A. 2, Act.	A. 1, Pass. and Mid.	A. 2 Pass. and Mid.
Nil.	εφυγον.	εφευξαμην.	Nil.
ἔποιησα.	Nil.	εποιηθην. (Pass.) εποιησαμην (Mid.)	Nil.
ἐπεισα.	επιθον.	ἐπείσθην (Pass.) ἐπεισάμην (Mid.)	ἐπίθην (Pass.) ἐπιθόμην (Mid.)
ελειψα.	ἔλῖπον.	ελειφθην (Pass.) ελειψαμην (Mid.)	ἔλιπην (Pass.) ἐλιπόμην (Mid.)
ἔλυσα.	Nil.	ἐλύθην (Pass.) ἐλυσάμην (Mid.)	Nil.
Nil.	ελαβον.	ἐλήφθην (Pass.)	ἐλᾶβόμην (Mid.)

(5) *Comparative*—

κουφότερος | σαφέστερος | μείζων, κακίων, χείρων, ἥσσων | ἐλάσσων

Superlative—

κουφότατος | σαφέστατος | μέγιστος | κάκιστος, χείριστος | ἐλάχιστος

Domestic Economy.

SECTION I.

1. What materials and appliances would be required for the teaching of needlework to Standards III. and IV.; and what ought children in those standards to be able to do in order to fulfil the requirements of the Code.

Materials for Standard III.—Calico, print, canvas, flannel, wool.

Materials for Standard IV.—Calico, flannel, stocking-web, wool.

(Requirements are given in the Code, which candidates must get up thoroughly.)

2. Explain in what ways the methods of patching flannel, calico, and print differ from each other, and give the reason for the difference.

In patching flannel, instead of turning the edges in and sewing them, the edges are left raw and then herring-boned round.

In the case of calico the edges are turned in, the patches being 'seamed on' on the right side, and felled on the wrong side.

In patching print it is necessary to be particular to match the pattern. In putting on the patch it is sewn on in the same way as calico in the front; but the raw edge at the back is not turned in and hemmed, as in calico, but buttonholed round, in order that the stitches may not show. Flannel is herring-boned to prevent the patch looking clumsy, as it would do if hemmed.

SECTION II.

1. How would you apportion an income of £60 per annum for a single woman not living with her parents.

	£	s.	d.
Board, lodging, and washing, at 15s. a week	39	0	0
Dress, travelling expenses, and incidental expenses	12	10	0
Save yearly	8	10	0
	60	0	0

Dress.	£	s.	d.
Winter dress, yearly	2	0	0
Summer ,, ,, ...	2	0	0
1 pair boots, 1 pair shoes	1	0	0
Hat		8	0
Gloves, stockings, linen, &c...	2	2	0
	£7	10	0

2. What facilities exist in England for the encouragement of saving, in the case (1) of a child who can save two or three pence at a time; (2) of a shop assistant who can save a shilling a week; (3) of a teacher who is paid monthly, and can save 12s. per month? What is the rate per cent. of interest allowed by the Post Office, and how is it calculated? Give an example.

(1) The Penny Bank system in connection with the Post Office Savings' Bank; also the purchase of stamps which are affixed to a form supplied by the Post Office, and which, when they reach a shilling, can be paid into the Post Office and receive interest.

(2) Post Office Savings' Bank; Building Societies.

(3) Post Office Savings' Bank; Building Societies; Post Office Annuities. The Post Office Savings' Bank pays 2½ per cent. per annum. No interest is paid on any sum less than one pound, nor for a shorter period than one month.

Example.—Suppose I pay in on September 1st, 21 shillings; on October 5th, 25 shillings; and on December 18th, 40 shillings; when the interest is calculated at the end of the following August, I shall receive a full year's interest on the first 20 shillings; 10 months' interest on the 20 shillings; and 8 months' on the 40 shillings.

SECTION III.

1. Name the different purposes which are served by eating and drinking; and the principal kinds of substance which are needed to sustain the health and strength of the body?

(*a*) *Purposes of Food.*—

(1) To supply warmth to the body.

(2) To build up the frame.

(3) To supply what is used up in the body by work performed.

(4) To make blood, flesh, bone, &c.

(5) To give activity and power to body and brain.

(6) To please the palate.

(*b*) *Principal Substances to be supplied by food.*—
Carbon, Nitrogen, Sugar, Starch, Hydrogen, Fat or Oil, Phosphorus.

2. What does milk contain? Say why it is suitable for children. Is there any other article of diet which would serve the purpose equally well?

Milk contains all the substances necessary to constitute a perfect food. Albumen, Starch, Fat or Oil and Salts are present in proportions suitable for the digestive organs of children.

It is suitable for children as being the natural food provided for them, and as containing all the essential elements of food; and as being easy of digestion and very nutritious.

There is no food ready to hand that is nearly so suitable for infant food; but several prepared foods which contain the same elements in nearly the same proportions furnish a change.

SECTION IV.

1. Name the chief ingredients which can be made use of in the preparation of soup. Give two recipes for the making of cheap and nourishing soups.

(*a*) Bones, stock, peas, lentils, onions, carrots, turnips, celery, salt, pepper, macaroni.

(*b*) *1st Recipe. Potato Soup*—Four middle-sized potatoes well pared; a thick slice of bread; six leeks peeled, and cut into thin slices as far as the white extends upwards from the roots; a teacupful of rice: a tea-spoonful of salt; pepper to taste, and two quarts of water or stock.

2nd Recipe. Pea Soup—¼ lb. onions, ¼ lb. carrots, 2 oz. celery, ¾ lb. split peas, a little mint shred fine: one table-spoonful of coarse brown sugar: salt and pepper to taste; four quarts of liquor in which a joint of meat has been boiled.

2. Do you think hot or cold food the more wholesome? Give your reasons; and add any rules which you think useful for keeping uncooked meat.

(*a*) Hot food is the more wholesome as being the more easily digested; moreover, many articles of food lose the best of their flavour when cold.

(*b*) To keep uncooked meat:—(1) Keep as cool as possible; (2) Give as much air as possible; a good plan is to hang it in a safe suspended in a tree in full foliage; (3) Wipe it every day with a dry cloth, or brush it over with an antiseptic of some kind; (4) Freeze it or pickle it.

SECTION V.

1. What would you do in each of these cases:—(1) If a child had a fall and became unconscious; (2) if he sprained his ankle; (3) if he drank boiling water; or (4) if he fainted in school?

(1) To restore consciousness, loosen clothes round neck; give plenty of air; raise the head; apply smelling-salts to nose, and hot bottles to the feet. For treating the contusion: lay a piece of folded lint well wetted with extract of lead on the part, and if the pain is excessive, place a hot bran poultice over the dressing.

(2) Put white of egg into a saucer; keep stirring with a piece of alum about the size of a walnut till it becomes a thick jelly? apply a portion on a piece of lint large enough to cover the sprain, changing it for a fresh one as often as it feels warm or dry; keep the leg horizontal.

(3) Make him immediately drink some salad oil.

(4) Lay child flat on his back, loosen clothes round neck or wherever tight. Dash cold water on face. Apply smelling bottle. Bathe round mouth with vinegar and water, and on recovery give to drink diluted sal-volatile.

2. Explain how you would set about the thorough cleaning of a bed-room, and by what means such a room can best be kept in a wholesome condition.

(*a*) Brush mattresses of the bed before it is made, then make the bed, shake the curtains; lay them smoothly on the bed; pin or tuck up the bottom vallance, so that it can be swept under the bed; unloop the window curtains, shake them, and pin them high up out of the way. After clearing the room altogether of little articles of china, &c., shake and fold toilet covers, and place them on the bed, over which a large dusting sheet should be drawn. Then sweep the room, first of all sprinkling the carpet with well-squeezed tea leaves or freshly pulled grass. Clean grate; wash with soap and water the washing table apparatus, &c., &c.; scrub the floor where it is not covered with carpet, as little soap and soda as possible being used, as too much of these blacken the boards. Dust the furniture, blinds, ornaments, &c.; remove the cover from the bed, and straighten and arrange the curtains and counterpane.

(*b*) A bed-room should be cleaned as above every week. There are times when it is necessary to have the carpet up; this should be done at least once a year in the country and twice a year in large cities. The best time for these arrangements is spring and autumn, when the bed furniture requires changing to suit the seasons of the year. After arranging the furniture, it should all be well rubbed and polished, an old silk handkerchief or very soft duster being best for the purpose. Three or four times a year a good polish should be applied, taking care not to put too much of the polish on at one time, and to rub, not smear it, over the articles.

SECTION VI.

Give some simple rules respecting the best way of washing clothes. Are any special precautions necessary in washing coloured and woollen articles? If so state them, and give your reasons.

Every article having been examined and assorted, the sheets and fine linen should be placed in one of the tubs, and just covered with lukewarm water in which a little soda has been dissolved and mixed, and left to soak till the morning. The dirtier things should be laid to soak in another tub, with sufficient liquor to thoroughly wet and just cover them. On the following morning the fine linen should be taken first, each article being removed in succession from the lye, rinsed, rubbed, and wrung, and the foul water drawn off. The tub refilled with lukewarm water, in which the articles should again be plunged, and each gone over carefully with soap, and rubbed. After the first washing, the linen should be put into a second water, as hot as the hand can bear it, and again rubbed over in every part till thoroughly clean; boil for twenty minutes and rinse in the usual way. The dirtier articles are to be treated in the same way. Coloured articles require milder treatment; any application of soda will discharge the colour, and soaking all night even in pure water deteriorates the more delicate tints. They should be put into cold water and washed very speedily, using the common yellow soap, which should be rinsed off immediately, and the things then dried in the shade. Woollen articles are liable to shrink. This liability is increased when very hot water is used. Cold water would thus be the best to wash woollens in; but as this would not remove the dirt, lukewarm water and yellow soap are recommended. They require a good deal of rinsing in cold water to remove the soap.

2. Do you think it desirable that flannel or other woollen material should be worn by children next to the skin? If so, explain the reason.

Woollen or flannel clothes should be worn next the skin by all, and especially by children, who so often heat themselves to such an extent that they throw off a great deal of perspiration, the evaporation of which, if they had linen next their skin, would probably give them a chill, as the linen would dry faster, whereas flannel soaks up the moisture, conducts heat very badly, and does not dry fast.

Recent Inspection Questions.

Arithmetic.

STANDARD I.

1. Add 46, 723, 497, 86, 29. 1,381. Ans.
2. From 450 take 129. 321. Ans.
3. From 163 take 87. 76. Ans.
4. 4 × 9; 3 × 6; 3 × 2.

(Writing.)

A.

Dashing, down, rich, went, blew, breeze, hard, bright, breast, salt.

B.

Snow, frost, very, high, hills, person, kind, save river, blew.

STANDARD II.

A.

1. From 51,476 take 9,865. 41,611. Ans.

2. 5,902 ÷ 12. $491\frac{10}{12}$. Ans.

3. 47,208 ÷ 7. 6,744. Ans.

4. 8,655 ÷ 809. 7,001,895. Ans.

B.

1. From 76,911 take 3,895. 73,016. Ans.

2. 56,789 ÷ 12. $4,732\frac{5}{12}$. Ans.

3. 56,789 × 98. 5,565,322. Ans.

4. 94,300 ÷ 7. $13,471\frac{3}{7}$. Ans.

STANDARD III.

A.

1. From £1,009 6s. 8d. take £900 2s. 9½d.
£109 3s. 10½d. Ans.

2. Add £276 13s. 0¾d., £8,094 17s. 10½d., £933 9s. 1d., £7,657 15s. 9¼d., and £28 4s. 7½d.
16,991 0s. 4¾d. Ans.

3. Divide one million three hundred and five thousand seven hundred and seventy-two by three hundred and eighty-six. $3,382\frac{320}{386}$. Ans.

4. A lady spent 10s. 5d. at the butcher's and 6s. 11d. at the grocer's; she had then spent 3d. more than half of what she had at first. How much had she at first?
£1 14s. 2d. Ans.

B.

1. Add £37,895 17s. 9¾d., £2,788 16s. 8¾d., £93,001 19s. 2½d., £653 5s. 11¼d., £11,326 18s. 10d.
£145,666 18s. 6¼d. Ans.

2. From £37,900 4s. 0¼d. take £8,919 17s. 1½d.
£28,980 6s. 10¾d. Ans.

3. Divide eight million eight hundred and eight thousand four hundred and seventeen by ninety-seven.
$90,808\frac{47}{97}$. Ans.

4. A family spends 18s. 11d. per week. The man earns 12s. 6d. per week; his two sons 4s. 7d. each per week; his daughter 3s. 6d., and his wife 2s. 6d. How much is left?
(12s. 6d. + 4s. 7d. + 4s. 7d. + 3s. 6d. + 2s. 6d.) −18s. 11d. = 8s. 9d. Ans.

STANDARD IV.

1. £90 10s. 9½d. × 680.
61,566 18s. 4d. Ans.

2. £98,298 15s. 9¾d. ÷ 908.
£108 5s. 2 $\frac{215}{908}$d. Ans.

3. In 67,568 sq. yds. how many acres, &c.?
13a. 3r. 33p. $19\frac{3}{4}$ yds. Ans.

4. How many steps will be taken in a mile if each step is a yard long?
1760 steps. Ans.

B

1. £3,407 16s. 4½d. × 37.
£126,089 5s. 1½d. Ans.

2. £16,909 18s. 4d. ÷ 58.
£291 11s. $0\frac{4}{58}$d. Ans.

3. A farmer bought 27 sheep at £1 7s. 6d. each, and sold them all for £48 19s. 9d. What did he gain?
£11 17s. 3d. Ans.

4. Reduce 109,909,875 feet to leagues.
6,938 lea. 2 m. 2 f. 4 p. 3 yds. Ans.

STANDARD V.

A

1. 21 miles 6 f. 1 p. @ £15 12s. 10d. per mile.
£340 5s. $1\frac{74}{80}$d. Ans.

2. Find the difference between the sum and difference of ½ and ⅝.
$(\frac{1}{2} + \frac{5}{8}) - (\frac{5}{8} - \frac{1}{2}) = \frac{8}{8}$ or 1. Ans.

3. A watch loses 3 min. 48 sec. in 19 days. How much will it lose in three weeks?

days	days	m.	s.		m.	s.
19	: 21	:: 3	48	:	4	12. Ans.

4. Make a bill for 13 tons of best coal @ 19s. 7d. per ton, 2 tons 15 cwt. at 6s. per ton, 2 tons 19 cwt. of coke @ 10½d. per cwt., 2½ loads of firewood @ 5s. 9d. per load.
(£12 14s. 7d, + 16s. 6d. + £2 11s. 7½d. + 14s. 4½d.) = £16 17s. 1d. Ans.

B

1. 3,009 acres at 19s. 4½ per rood.
£11,659 17s. 6d. Ans.

2. Take $\frac{3}{7}$ from $\frac{2}{7} + \frac{5}{6} + \frac{1}{4}$.
$\frac{79}{84}$. Ans.

3 A farmer pays one farthing for a square yard of land. His rent is £363. How many acres are there in his farm?
72 acres. Ans.

4. Make a bill for 17 lbs. of rice at 2⅜d. per lb., 5½ lbs. of coffee at 1s. 6d. per lb., 17½ lbs. tea at 3s. 6d. per lb., 5 tins of biscuits, each 17 lbs., at 7d. per lb. (3s. 6½d. + 8s. 3d. + £3 1s. 3d. + £2 9s. 7d.) £6 2s. 7½d. Ans.

STANDARD VI.

A.

1. Find the simple interest on £250 at 4 per cent. per annum from March 1st to 24th July, both days inclusive.
Time = 146 days. $\frac{2}{5}$ of £10 = £4. Ans.

2. Divide 3955·8 by ·075 and multiply the quotient by ·0005. 26·372. Ans.

3. Find what decimal of £1 is $\frac{2}{3}\frac{4}{5}$d. ·004. Ans.

4. How many times may $2\frac{3}{5}$ be subtracted from $50\frac{3}{7}$.

$50\frac{3}{7} \div 2\frac{3}{5} = 18\frac{9}{14}$ times. Ans.

B.

1. Reduce £2 17s. 9d. to the decimal of £5 10s. 6d.

·5226+. Ans.

2. Find the income of a man who has £5,600 lent on a mortgage at $4\frac{1}{2}$ per cent., and £3,500 invested at $3\frac{1}{4}$.

£374 10s. Ans.

3. 14 men can do a piece of work in 37 days; how many men can do it in 15 days sooner?

Days, 22 : 37 :: 14 men : $23\frac{6}{11}$ men. Ans.

4. Simplify $(\frac{2}{7} - \frac{1}{3}) \div (\frac{1}{2} - \frac{1}{4}) + \frac{2}{5}$.

$1\frac{97}{105}$. Ans.

STANDARD VII.

A

1. A bankrupt can only pay 16s. 8d. in the £. What percentage of their money will his creditors lose?

$\frac{1}{6}$ of 100 = $16\frac{2}{3}$ per cent. Ans.

2. The average earnings of a man, his wife, and three children were 18s. per week each. The man earned twice as much as his wife, and the wife three times as much as each child. How much did each child earn per week?

Total earnings, 18s. × 5 = 90s.

Shares = 1 for each child (3) + 3 for wife + 6 for man = 12. 90 ÷ 12 = 7s. 6d. Ans.

3. A certain sum of money put into a bank at simple interest doubled itself in $12\frac{1}{2}$ years. Find the rate per annum.

£1 : £100 :: £1 : £8 per cent. Ans.

yrs. $12\frac{1}{2}$: 1

4. A man left a sum of money to be divided between his children, so that half of it shall be divided between his seven sons equally, and the other half between his eight daughters equally. Each son had £1 18s. 6d. more than each daughter. What was the whole amount divided between them?

$(\frac{1}{2} \div 7) - (\frac{1}{2} \div 8) = \frac{1}{112}$ = £1 18s. 6d.

$\frac{112}{112}$ = £215 12s. Ans.

B

1. The cost of keeping 48 men for 8 weeks was £160 4s. How much would it cost to keep 42 men for 18 weeks?

weeks 8 : 18 :: £160 4s. : £315 7s. $10\frac{1}{2}$d. Ans.

men 48 : 42

2. A man sold a table for £5 12s. 6d., realizing a profit of $12\frac{1}{2}$ per cent. Find the cost price.

$112\frac{1}{2}$: 100 :: £5 12s. 6d : £5. Ans.

3. A sum of £75 is to be divided among 3 persons. The first gets ·2 of the whole, the second ·75 of the remainder. What does each get?

first ·2 = $\frac{1}{5}$ of £75 = £15

second ·75 of $\frac{4}{5}$ = $\frac{3}{5}$ of £75 = £45

third $\frac{1}{5}$ = £15. Ans.

4. A, B, and C went into business. A had £360, B had £240, and C had £120. At the end of the year the profits were £720 15s. $10\frac{1}{2}$d. What was B's share?

360 + 240 + 120 = 720

720 : 240 :: £720 15s. $10\frac{1}{2}$d. :

£240 5s. $3\frac{1}{2}$d. Ans.

Physiology.

1. What are proteids?
2. What are the differences between venous and arterial blood?
3. Draw a diagram of the left section of the heart.
4. What are capillaries, arteries and veins?
5. What glands are in the mouth?
6. Describe the course of the blood from the right auricle to the left ventricle.
7. Name and describe the position of the bones of the cranium.
8. Make a drawing of a molar.
9. Write as much as you can about incisor, canine, and bicuspid teeth.
10. Describe the ribs and explain the action of the intercostal muscles.
11. Draw a diagram of the trunk, showing the position of the heart, lungs, and windpipe.
12. Describe the liver, stomach and intestines.
13. Draw a diagram of the leg.
14. What are inflexors and extensors?

Mental Arithmetic.

STANDARD II.

How much is $7\frac{1}{2}$d. less than 1s.? Take 4 times 7 from 6 times 8. How many twopenny loaves can be had for 2s.? Add 5, 9, 4, 7 and 5, and divide by 5. Six doz. nuts are divided among eight girls; how many for each? Take 4 times 7 from 5 times 9. What is eight times the half of 3d.? 4 × 7, + 5, ÷ 3. How many penny pencils for 2s. 6d.? Add 7, 8 and 9 ÷ 3, double it. 4 doz. oranges at $\frac{1}{2}$d. each? 10 outside a 'bus at 2d. each, and 4 inside at 3d., how much? How many 3d. copies for 5s.? 7 + 9 + 5 + 8 + 6 ÷ 7 = ? Subtract 5 twelves from 10 sixes. How many farthings in a shilling? In a crown how many threepences? Add 7, 5 and 4, ÷ 2, × 11.

Grammar.

STANDARD IV.

Parse:

1. Mary soon lost her doll.
2. Mice spoil much food.
3. Clouds often bring rain.
4. More snow fell on us.
5. That stool has three legs.
6. You write these copies.

Oral questions:—

What is an interjection? Give one. What is an adverb? What sort of an adverb is *steadily? Wisely? Soon?* How many numbers have nouns? How is the plural made? (Ans. By adding *s*.) Always? Some other ways? What is the plural of *foot?*

Fish? *Child?* *Baby?* What gender is *man?* *Dog?* Why? What is the feminine of *nephew?* *Uncle?* *Gentleman?* *Tiger?* *King?* When should we use capital letters? What prououn always has a capital letter?

STANDARD V.

Parsing (words in italics given):—

1. *You forgot that* she *was* a *gipsy*.

2. It *is true that* tea *first* came from China.

3. The *person whom you* expect will arrive *soon*.

Oral questions:—

What are the three chief tenses of verbs? How is the past tense formed? (Ans. By adding *d* or *ed* to the present.) Always? Give an example of another way. What is the present tense of *went?* Of *brought?* Of *trod?* Of *struck?* What is a relative pronoun? Give an example. What is meant by a verb agreeing with its subject in number and person? What are the two chief parts of a sentence? Analyze this sentence—'Who spoke there?' 'I tore my coat badly.' 'Monkeys are very mischievous.' Why do you put mischievous in the predicate?

STANDARDS VI. and VII.

Parsing (words in italics) and analysis:—

1. *If* you *work your* sums *correctly* I shall be pleased.

2. We *found that* the water was *too deep*.

3. I *was interrupted* by a girl *who* questioned *me respectfully*.

What sort of a sentence is 'If you work, &c.?' Are there any other kinds of subordinate sentences? Pick out the subordinate sentence in No. 2. What kind is it? In No. 3. What kind is it? How do you know an adjective sentence? What is wrong in this sentence—'It was him who broke the window?' Correct it. What rule is broken? What do extensions of the predicate consist of? What voices have verbs? What is the passive voice? How is it formed? Change the verb in the sentence 'We saw you,' into the passive voice without altering the meaning of the sentence.

Query Column.

RULES.

1. **Each correspondent is restricted to *one question*.** We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. MISTY.—Large hand, good, clear, regular, rather too upright, 85. Small hand legible, well formed, rather too upright, 90. The book is held 5·5 inches from a wall and casts a shadow which on measurement is found to contain 400 square inches; the book, you say, is brought 2½ inches nearer, but you do not say whether you mean nearer to the source of light or nearer the wall. If you move it so that it is 3 inches from wall the shadow will be less. Then $(5\frac{1}{2})^2 : (3)^2 :: 400 : x$ and $400 - x$ is the amount by which the shadow is diminished.

2. MAGISTER.—Your suggestion has been referred to the Editor.

3. J. W. DUCK.—Read the Code for yourself. Where there is no direct information of the sort you wish you must use your judgment. Do not take it for granted that it is the business of the inspector to take advantage of you. Most likely you will get everything you could reasonably expect. To count one day as a week might be a positive hardship. We do not think you will be asked to reckon it as such.

4. YORKSHIREMAN.—Large hand shows points of real excellence. The E is too far from the d, and the h is not of the form used in large hand. The other letters are well made, 90. The small hand is also of good quality. It is correct in form and graceful in shape. Practice of the best models would add to its elegance. It will meet all requirements as it is, 90.

5. NERO.—If there is no reference to age it will not matter. If there is any regulation it will be rigidly enforced.

6. F. L. G.—The large hand is promising. We cannot say more. You need to practise good copies for some months for a few minutes each day. You must not write so upright, and you do not hold your pen correctly, as the jagged edges of some of the curves clearly proves. The small hand is on the whole very much better, but the faults in that are serious and many; only practice will get you out of them. Some of the faults are those of carelessness, not of penmanship. For instance, you write the first letter of Hindoo correctly enough, but the first letter of Hole is as bad as you could make it.

7. A. P.—Any school arithmetic will explain your questions. They are quite common and quite easy where you have worked through an arithmetic like *Colenso's*, *B. Smith's*, *Lock's*, or any of the host of good books now in the market. *De Morgan's* book is truly excellent. From your questions we think *B. Smith's* or *Lock's* would suit you better; price about 4s. 6d. Handwriting: large hand only fair; letters wrongly shaped and badly curved, 50. The small hand has the same faults, 50.

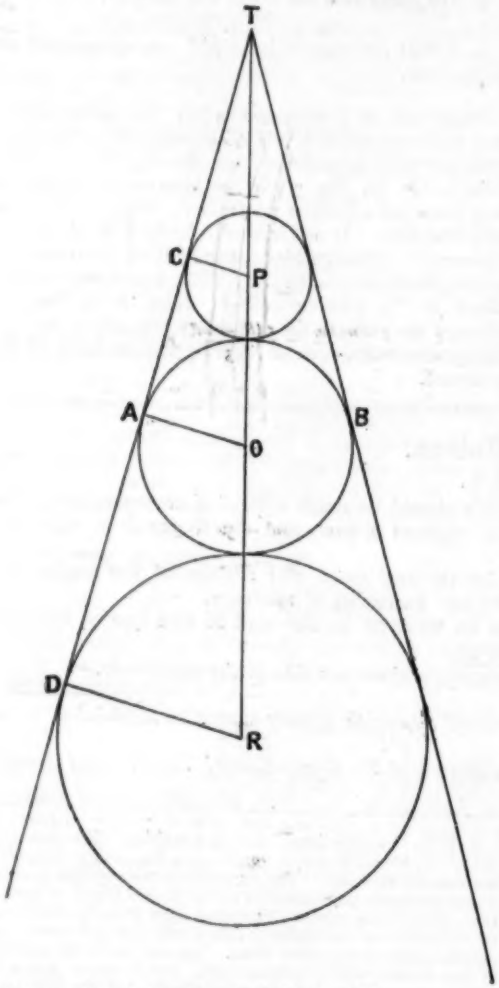
8. FESTINA LENTE.—Read the notes previously written in this magazine on the course you propose, and also the few that are appearing now. We shall be glad to assist you at any time. Write freely. We shall name books as we go on. Extract from the Task was written legibly. The writing has no other merit at all. It is no use expecting to write a good hand without careful and continued practice of good models. Now there is hardly a single letter of all you have sent which is a correct copy of one you ever saw in a good copy book.

9. SIGMA.—You will find the solution of your query in our issue for March, 1887.

10. FABRIOLA.—TA and TB are two tangents to a circle, whose centre is O and whose radius is r.

Show that the radii of the two circles which can be drawn to touch this circle and the two tangents TA and TB are $r\frac{1-\sin\alpha}{1+\sin\alpha}$ and $r\frac{1+\sin\alpha}{1-\sin\alpha}$, where α is the angle OTA.

(*Pinkerton's* 'Elementary Trigonometry.')



Let r_1 and r_2 denote the radii of the two circles.

$$\frac{OA}{OT} = \sin OTA,$$

$$OA = OT \sin\alpha,$$

$$r = (OP + PT)\sin\alpha,$$

$$= (r + r_1)\sin\alpha + PT\sin\alpha,$$

Now, $\frac{PC}{PT} = \sin PTC,$

$$PC = PT\sin\alpha,$$

$$r_1 = PT\sin\alpha,$$

$$\therefore PT = \frac{r_1}{\sin\alpha}.$$

$$\therefore r = (r + r_1)\sin\alpha + \frac{r_1}{\sin\alpha} \times \sin\alpha$$

$$= r\sin\alpha + r_1\sin\alpha + r_1$$

$$r_1 + r_1\sin\alpha = r - r\sin\alpha$$

$$r_1(1 + \sin\alpha) = r(1 - \sin\alpha)$$

$$\therefore r_1 = r\frac{1-\sin\alpha}{1+\sin\alpha}.$$

$$\frac{RD}{RT} = \sin RTD,$$

$$RD = RT\sin\alpha,$$

$$r_2 = (RO + OT)\sin\alpha$$

$$= (r + r_2)\text{s.n}\,\alpha + OT\sin\alpha$$

$$= (r + r_2)\sin\alpha + \frac{r}{\sin\alpha} \times \sin\alpha$$

$$= r\sin\alpha + r_2\sin\alpha + r,$$

$$r_2 - r_2\sin\alpha = r + r\sin\alpha,$$

$$r_2(1 - \sin\alpha) = r(1 + \sin\alpha),$$

$$\therefore r_2 = r\frac{1+\sin\alpha}{1-\sin\alpha}.$$

And, $r_1 r_2 = r\frac{1-\sin\alpha}{1+\sin\alpha} \times r\frac{1+\sin\alpha}{1-\sin\alpha}$

$$= r^2.$$

Note.—Please refer to the Rules.

11. JEAN.—A lump of iron (s. g. $7\frac{1}{4}$) floats on surface of mercury (s. g. $13\frac{1}{2}$). Water is poured on the mercury till the iron is covered. What portion of the iron will now be immersed in the mercury? The iron floats in the mercury so as to displace a volume of mercury equal to its own weight. When the iron floats in mercury let the volume of the iron immersed be y then the part not immersed is $1 - y$ and

$$13\tfrac{1}{2}y = 1 \times 7\tfrac{1}{4}$$

$$y = \frac{7\frac{1}{4}}{13\frac{1}{2}} = \frac{29}{54}$$

When water is poured on the mercury till the iron is covered the iron rises in the mercury, because it is partly supported by the water. Let x be now the part immersed in the mercury.

Then $13\frac{1}{2}x + (1 - x) = 7\frac{1}{4}$

$$12\tfrac{1}{2}x = 6\tfrac{1}{4} \quad \therefore x = \tfrac{1}{2}$$

that is half the volume of the iron is immersed in the mercury and half in the water.

12. THALAMIFLORÆ.—

Yet—adverb, qualifying once.
once—adverb, qualifying more.
more—adverb.
from—adverb, qualifying beneath.
beneath—preposition, governing seat.
Hence—adverb, qualifying a word like '*send*,' understood.
so—adverb.
together—adverb, qual. drove.
both—numeral adjective qual. we.
heard—verb regular, intransitive, past tense, active voice.
what—relative pronoun, used adjectively.
time—noun, common, singular, neuter, objective case gov. by heard.

13. FOLKSTONIAN.—O dear me = Oh dear, an interjectional phrase; corruption of an Italian oath; me, accusative of exclamation.

14. DAISY.—By taking a long series of observations at different places, the mean temperature of each is ascertained, and lines can then be drawn on a map, passing through those places which have the same mean annual temperature. These lines are called *Isothermal* lines. They were first noticed by Humboldt, and serve to show the general distribution of temperature. On the sea they are almost parallel, but on the land they are somewhat irregular, as elevation above the sea-level greatly influences the temperature.

The *range* of temperature means the difference between the maximum and minimum readings.

The climate of any place does not depend alone upon the *mean* temperature, for the *range* of temperature exerts a very important influence upon it.

The importance of observing the *range* of temperature is shown by the fact, that the rate of mortality is found to vary with the range.

An insular climate usually has this range very limited in extent.

15. A MATHEMATICIAN.—There are many examinations in training colleges. Only those papers are published which are issued by the Government Department. These, whether for the scholarship or for certificates can be purchased through any bookseller for sixpence each.

16. L. A.—You will notice that your query was sent by another correspondent.

Algebra.

1. FERGUSSON.—Find the present value of an annuity of £247, payable by *monthly* instalments of £20 11s. 8d. each, for 14¼ years, *i.e.*, 171 months, reckoning compound interest at 5 % per annum.

Let P denote the present value in pounds, A a monthly instalment in pounds, R the amount of one pound in one month, and n the number of months.

Then, $PR^n = \frac{R^n - 1}{R - 1} A$;

That is, $P \times (\frac{241}{240})^{171} = \frac{(\frac{241}{240})^{171} - 1}{\frac{241}{240} - 1} \times \frac{247}{12}$

$$\left\{\begin{aligned} \text{Log. } (\tfrac{241}{240})^{171} &= (\log. 241 - \log. 240) \times 171 \\ &= (2{\cdot}3820170 - 2{\cdot}3802112) \times 171 \\ &= {\cdot}0018058 \times 171 \\ &= {\cdot}3087918 \\ &= \log. 2{\cdot}0360656 \end{aligned}\right.$$

$$\therefore P \times 2{\cdot}0360656 = \frac{1{\cdot}0360656}{\frac{1}{240}} \times \frac{247}{12}$$

$$= 1{\cdot}0360656 \times \frac{247}{12} \times \frac{20}{\frac{1}{240}}$$

$$\therefore P = \frac{10360656 \times 247 \times 5}{2590164}\,£$$

$$= 2590164 \times 247$$

$$\begin{array}{r} 18131148 \\ 10360656 \\ 5180328 \\ \hline 639770508 \end{array}$$

$$\begin{array}{r|l} & 5 \\ 1272541 & 3198852540\,(2513£ \\ & 2545082 \\ \hline & 6537705 \\ & 6362705 \\ \hline & 1750004 \\ & 1272541 \\ \hline & 4774630 \\ & 3817623 \\ \hline & 957007 \\ & 20 \\ \hline & 19140140\,(15s. \\ & 1272541 \\ \hline & 6414730 \\ & 6362705 \\ \hline & 52025 \end{array}$$

$$= £2{,}513\ 15s.\quad \text{Ans.}$$

Note.—The process by ordinary Arithmetic would be very tedious, as $(\frac{241}{240})$ has to be raised to the 171st power.

2. ANNIE LINDSAY.—Find the values of v_1 and v_2 from the following :—

$$\left.\begin{aligned} 2av_1 + bv_2 &= a^2 \\ av_2 - 2bv_1 &= b^2 \end{aligned}\right\}.$$

$$\left.\begin{aligned} (1)\quad 2av_1 + bv_2 &= a^2 \\ (2)\quad -2bv_1 + av_2 &= b^2 \end{aligned}\right\}$$

$$\left.\begin{aligned} (1) \times a\quad 2a^2v_1 + abv_2 &= a^4 \\ (2) \times b\quad -2b^2v_1 + abv_2 &= b^4 \end{aligned}\right\}$$

Subtracting $\quad 2(a^2 + b^2)v_1 = a^4 - b^4$

$$= (a^2 + b^2)(a^2 - b^2)$$

$$2v_1 = a^2 - b^2$$

$$\therefore v_1 = \tfrac{1}{2}(a^2 - b^2).$$

$$(1)\quad a(a^2 - b^2) + bv_2 = a^3$$

$$bv_2 = a^3 - a(a^2 - b^2)$$

$$= a^3 - a^3 + ab^2$$

$$= ab^2$$

$$\therefore v_2 = ab.$$

$$\left.\begin{aligned} \therefore v_1 &= \tfrac{1}{2}(a^2 - b^2) \\ v_2 &= ab \end{aligned}\right\}$$

3. NEDD.—Solve :—

$$3x + 5y = \frac{(8b - 2m)\,bm}{b^2 - m^2},$$

$$b^2x - \frac{bcm^2}{b + m} + (b + c + m)\,my = m^2x + (b + 2m)\,bm.$$

(*Hamblin Smith.*)

(1) $$3x + 5y = \frac{(8b - 2m)\,bm}{b^2 - m^2}$$

$$3x = \frac{(8b - 2m)\,bm}{b^2 - m^2} - 5y$$

$$\therefore x = \frac{(8b - 2m)\,bm}{3(b^2 - m^2)} - \frac{5y}{3}$$

(2) $$b^2x - \frac{bcm^2}{b + m} + (b + c + m)\,my = m^2x + (b + 2m)\,bm$$

$$(b^2 - m^2)\,x + (b + c + m)\,my = (b + 2m)\,bm + \frac{bcm^2}{b + m}$$

$$\frac{(8b - 2m)\,bm}{3} - \frac{5(b^2 - m^2)}{3}y + (b + c + m)\,my = (b + 2m)\,bm + \frac{bcm^2}{b + m}$$

$$3(b + c + m)\,my - 5(b^2 - m^2)\,y = (3b + 6m)\,bm - (8b - 2m)\,bm + \frac{3bcm^2}{b + m}$$

$$(3bm + 3cm + 3m^2 - 5b^2 + 5m^2)\,y = (8m - 5b)\,bm + \frac{3bcm^2}{b + m}$$

$$(8m^2 + 3bm - 5b^2 + 3cm)\,y = \frac{bm\,[(8m - 5b)(b + m) + 3cm]}{b + m}$$

$$= \frac{bm\,(8m^2 + 3bm - 5b^2 + 3cm)}{b + m}$$

$$\therefore y = \frac{bm}{b + m}.$$

$$\therefore x = \frac{(8b - 2m)\,bm}{3(b^2 - m^2)} - \frac{5bm}{3(b + m)}$$

$$= \frac{[(8b - 2m) - 5(b - m)]\,bm}{3(b^2 - m^2)}$$

$$= \frac{(8b - 2m - 5b + 5m)\,bm}{3(b^2 - m^2)}$$

$$= \frac{3(b + m)\,bm}{3(b^2 - m^2)}$$

$$= \frac{bm}{b - m}.$$

4. FERGUSSON.—Find the present value of an annuity of £247, payable *annually*, for 14¼ years, reckoning compound interest at 5 %.

Let P denote the present value in pounds, A the annuity in pounds, R the amount of one pound in one year, and n the number of years.

Then, $PR^n = \frac{R^n - 1}{R - 1} A$;

That is, $P \times (\frac{21}{20})^{14\frac{1}{4}} = \frac{(\frac{21}{20})^{14\frac{1}{4}} - 1}{\frac{21}{20} - 1} \times 247$

$$\left\{\begin{aligned} \text{Log. } (\tfrac{21}{20})^{14\frac{1}{4}} &= \log. 1{\cdot}05 \times 14\tfrac{1}{4} \\ &= {\cdot}0211892991 \times 14\tfrac{1}{4} \\ &\quad\ 14\tfrac{1}{4} \\ &\quad\ 847571964 \\ &\quad\ 211892991 \\ &\quad\ 5297324775 \\ &\quad\ {\cdot}301947512175 \\ &= \log. 2{\cdot}004 \times 2205\ldots \end{aligned}\right.$$

$$\therefore P \times 2{\cdot}0042205 = \frac{1{\cdot}0042205}{\frac{1}{100}} \times 247$$
$$= 20{\cdot}08441 \times 247$$

247
14059087
8033764
4016882
4960·84927

$$\therefore P = \frac{4960{\cdot}84927}{2{\cdot}0042205}\ £$$
$$= \frac{49608492700}{20042205}\ £$$
$$= \frac{9921698540}{4008441}\ £$$

4008441)9921698540(2475 £
8016882
19048165
16033764
30144014
28059087
20849270
20042205
807065
20
16141300(4s.
16033764
107536

$= £2{,}475\ 4s.$ Ans.

5. BLOBS.—Find the sum of the first n numbers of the form $4^r + 1$. (*Todhunter.*)

This is an Arithmetical Progression of which the first term is 1, and common difference is 4.

$$S = \left\{2a + (n-1)d\right\}\frac{n}{2}$$
$$= \left\{2 + 4(n-1)\right\}\frac{n}{2}$$
$$= (2 + 4n - 4)\frac{n}{2}$$
$$= (4n - 2)\frac{n}{2}$$
$$= n(2n - 1).$$

Mensuration.

1. LUCULLUS.—The volume of a sphere is equal to that of a right circular cylinder the radius of the base of which is one foot, and the height two feet; find the surface of each. (*Todhunter.*)

Volume of cylinder $= (1^2 \times 3{\cdot}1416 \times 2)$ cub. ft.
$= (3{\cdot}1416 \times 2)$ cub. ft.;

Volume of sphere $= \frac{4}{3} \times 3{\cdot}1416 \times \text{radius}^3$;

$\therefore \frac{4}{3} \times 3{\cdot}1416 \times \text{radius}^3 = (3{\cdot}1416 \times 2)$ cub. ft.

$\text{Radius}^3 = (2 \times \frac{3}{4})$ cub. ft.
$= \frac{3}{2}$ cub. ft.

$\therefore$ Radius of sphere $= \sqrt[3]{\frac{3}{2}}$ ft.

Surface of sphere $= 4 \times 3{\cdot}1416 \times \text{radius}^2$
$= [4 \times 3{\cdot}1416 \times (\sqrt[3]{\frac{3}{2}})^2]$ sq. ft.
$= 12{\cdot}5664 \times \sqrt[3]{2{\cdot}25})$ sq. ft.
$= (12{\cdot}5664 \times 1{\cdot}31037\ldots)$ sq. ft.

1·31037
879648
376992
1256640
376992
125664
16·466633568

Surface of cylinder $= [(1^2 \times 3{\cdot}1416 \times 2) + (2 \times 3{\cdot}1416 \times 2)]$ sq. ft.
$= [3{\cdot}1416 \times (2 + 4)]$ sq. ft.
$= (3{\cdot}1416 \times 6)$ sq. ft.
$= 18{\cdot}6496$ sq. ft.

Surface of sphere $= 16{\cdot}4666$ sq. ft.

Arithmetic.

1. W. M.—If the increase in the number of male and female criminals be 1·8 per cent., while the decrease in the number of males alone is 4·6 per cent., and the increase in the number of females is 9·8 per cent., compare the number of male and female criminals respectively. (*Barnard Smith.*)

(Number of male and female criminals) $\times \frac{1{\cdot}8}{100}$
$=$ Number of female criminals $\times \frac{9{\cdot}8}{100}$
$-$ Number of male criminals $\times \frac{4{\cdot}6}{100}$;

(Number of male and female criminals) $\times 18$
$=$ Number of female criminals $\times 98$
$-$ Number of male criminals $\times 46$;

Number of male criminals $\times$ 18 + number of male criminals $\times$ 46 = Number of female criminals $\times$ 98 − number of female criminals $\times$ 18;

Number of male criminals $\times$ 64 = number of female criminals $\times$ 80;

$\therefore$ Number of male criminals : number of female criminals
:: 80 : 64,
:: 5 : 4. Ans.

2. J. B. GREEN.—I bought 100 cards for 9s. 2d. and sold the lot so as to gain $\frac{1}{5}$ of the selling price. Find my selling price and also my gain per cent. (*Moffatt's* 'Pupil Teachers' Course.')

Selling price = Cost price + $\frac{1}{5}$ of Selling price,
$\frac{4}{5}$ Selling price = Cost price,
$\therefore$ Selling price = $\frac{5}{4}$ Cost price.
$= \frac{5}{4}$ of 9s. 2d.
$= \left(\frac{5}{4} \text{ of } \frac{11}{3}\right)$s.
$= \frac{55}{12}$s.
$= 4\frac{7}{12}$s.
$=$ 14s. 8d. Ans.

Cost price = $\frac{4}{5}$ Selling price,
$\therefore$ Gain on $\frac{4}{5}$ Selling price = $\frac{1}{5}$ Selling price,
$\therefore$ Gain per cent. = $\frac{5}{4}$ of 100
$=$ 60. Ans.

Or,

9s. 2d. : £100 :: 5s. 6d. : Gain per cent.
12 12
110 66
6

$=$ 60 per cent. Ans.

3. TYRO.—A person can discharge a debt by paying at the end of one, two, and three years, equal instalments of £1,771; what is the amount of the debt, interest being reckoned at 5%? (*Johnston's* 'Civil Service Arithmetic.')

£105 : £1771 :: £100 : Amount of debt for first instalment.
21 253 20
3 20
5060
£1686 13s. 4d.

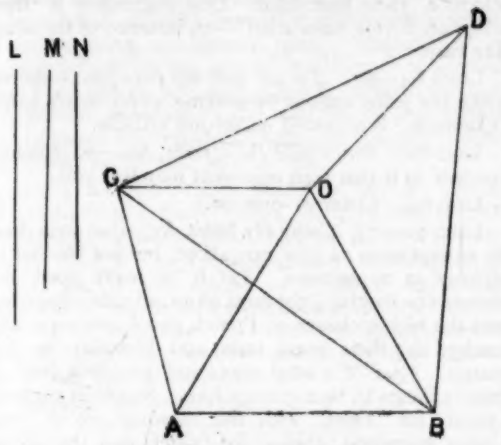
£110 : £1771 :: £105 : Amount of debt for second instalment.
161
$=$ £1610.

£115 : £1771 :: £100 : Amount of debt for third instalment.
23 77 20
20
£1540

$\therefore$ Amount of debt = £1,686 13s. 4d. + £1610 + £1540
$=$ £4,836 13s. 4d. Ans.

Geometry.

1. R. E.—Construct an equilateral triangle, the distances from a point in the triangle to the several angles being given. What are the conditions necessary? (*Stage I.*, 1884.)



Let L, M, N, represent the lengths of the distances from a point within the triangle.

Take AB = L, and upon it describe the equilateral triangle AOB; (I. 1.)

Upon AO construct the triangle ACO, having AC, OC = M, N, respectively; (I. 22.)

Join BC, and upon it describe the equilateral triangle BCD.

Then BCD shall be the equilateral triangle required.

Proof.—Join OD.

OB = AB = L, and OC = N;

$\angle$ CBD = $\angle$ ABO, each being an angle of an equilateral triangle;

Take away the common angle OBC, then $\angle$ OBD = $\angle$ ABC; (Ax. 3.)

And sides OB, BD = sides AB, BC, each to each.

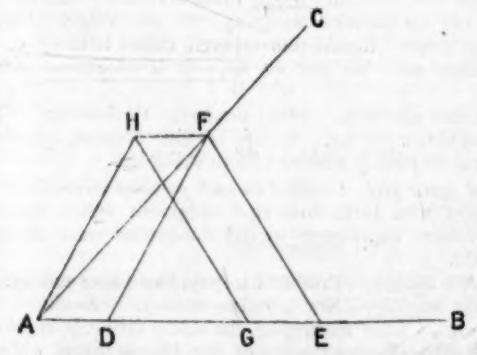
$\therefore$ Base OD = base AC = M. (I. 4.)

Therefore the equilateral triangle BCD is the triangle required. Q. E. F.

Note.—As we have to describe a triangle with sides equal to the three given lines, therefore any two of them must be greater than the third. (I. 20.)

2. HELPLESS.—Given two straight lines AB, AC, show how to describe an equilateral triangle DEF, whose sides are of a given length, so that D and E may lie in AB, and F in AC.

Under what circumstances will D and E lie on opposite sides of A? (*Stage I.* 1887.)



Construction—Make AG = given length of sides of equilateral triangle; (I. 3.)

Upon AG describe the equilateral triangle AGH; (I. 1.)

Through H draw HF parallel to AB, and meeting AC in F; (I. 31.)

Through F draw FD, FE parallel to HA, HG, respectively, and meeting AB in D and E.

Then DEF shall be the equilateral triangle required.

Proof— $\left.\begin{array}{l}\angle \text{FDE} = \angle \text{HAG} \\ \text{and } \angle \text{FED} = \angle \text{HGA}\end{array}\right\}$ (I. 29.)

$\therefore$ $\angle$ DFE = $\angle$ AHG; (I. 32.)

Wherefore triangle DEF is equiangular;

$\therefore$ Triangle DEF is equilateral; (I. 6, Cor.)

And its sides are equal to the given length, for FD = AH (I. 34.) = AG = given length. Q. E. F.

Note.—When the point H falls within the angle BAC, that is, when the angle BAC is greater than the angle of an equilateral triangle, or 60° (and less than 120°), the points D and E will lie on opposite sides of A.

When the angle BAC is greater than 120°, the points D and E will lie in BA produced.

—o—

Helps to the Study of Shakespeare's 'Hamlet.'

THE substance of the third scene of Act I. presents no great difficulty, but there are many peculiarities in the language that will repay attention.

Line 2. *As the winds give benefit*—when the winds prove favourable.

Line 3. *And convoy is assistant*—and means of conveyance are ready to hand. This use of *assistant* is adopted from the French *assister*, to be present.

Do not sleep—do not be negligent or forgetful.

Lines 5—9. *For Hamlet and the trifling*, &c.

As for Hamlet and his marks of attention think of them only as a passing fancy and a pastime on his part springing from the natural warmth and lightness of youthful feelings, pleasant but short-lived as a fair spring flower, breathing sweet odour that fills the air with pleasure for a passing hour. 'Primy nature'—nature in its first spring time; *prime* is elsewhere used for spring, but this is the only instance in Shakespeare of the word *primy*.

Line 8 lacks a syllable, and suggestions have been made to insert *tho'* before *sweet* or *not* after it. Abbott, however, points out how a pause is often made to supply the place of a syllable, and also how a monosyllable with a diphthong or long vowel often allows the voice to rest upon it, and so dispense with a syllable; 'forward' means premature.

'Suppliance' should be accented on the second syllable. It appears to be rather from Lat. *supplēre*, to fill up, to *supply*, than from *supplicāre*, to bend the knee to, as a *suppliant*. This word does not occur elsewhere.

Line 11. *Nature crescent*—growing nature, *crescent* being used in the literal sense of the Latin *crescens*.

Line 12. *thews and bulk*—strength and size, *thews* being an old word for muscles and sinews.

this temple waxes—this body grows. Here we have a reference to John ii. 21. Notice, too, the word 'service,' expressive of the action of the mind and soul developing with the body's natural growth.

Lines 15—16. *No soil nor cautel doth besmirch the virtue of his will*,—no unworthy thought nor crafty circumspection stains the honesty of his intentions.

Lines 19—24. *He may not as unvalued persons do*, &c.—He is not free, as people of no importance are, to choose only according to his own desire, for the welfare of the nation depends upon his choice, and he

is bound, therefore, in his choice, to regard the will and the needs of the nation as having the greatest weight. 'Unvalued'—of no worth. In Richard III. this word is applied to 'jewels,' with the meaning invaluable, or of untold worth.

'Safety' must be pronounced in three syllables. The folios have 'sanctity,' and Theobald suggested 'sanity.'

Lines 25—28. *It fits your wisdom*, &c.—It behoves you to trust his word only so far as he is able, in his peculiar position, to make it good, and this only so far as may be approved by the general voice of the people.

Line 30. *too credent*,—too trustful.

list his songs, listen to his words. *list* is used transitively.

Line 32. *unmaster'd importunity*, — unrestrained, passionate entreaty.

Lines 34—36. *the rear, the shot, and danger*, are all military terms. *chariest*, most careful or scrupulous.

Lines 39—40. *The canker galls the infants of the spring*, &c.—The canker-worm spoils the young roses too often before the buds be opened.

Line 42. *blastments*, blights. This is a hybrid word, formed by adding a Latin affix, *ment*, to an English stem. Such hybrids are common enough, but 'blastment' is not used elsewhere in Shakespeare.

Line 44. *Youth to itself rebels, though none else near*—Though no special temptation be present passion often leads the young against their own interest to revolt against customary restraint.

Line 46. *Good my brother*—In this form of address, which is common in Shakespeare, the pronoun *my* by frequent connection with the noun seems to become a part of the word, and resists separation by the insertion of a qualifying adjective. Compare the French words *monsieur, madame*.

Line 47. *ungracious pastors*—ministers lacking grace. The affix *ous*, meaning full of, is neutralised by the prefix *un*, not.

Line 49. *Whiles*—while or whilst; *reckless libertine*, careless profligate; 'libertine,' from *libertas*, contains the idea of liberty degenerated into licence.

Line 50, *primrose path of dalliance*.—Compare 'Macbeth,' Act II., Scene 2, 'primrose way to the everlasting bonfire.' *Facilis descensus Averni*.

Line 51. *Recks not his own rede*—heeds not his own counsel; 'recks' is from the root of reckon, reckless; 'rede' is not used elsewhere by Shakespeare.

fear me not—do not fear for me; 'me' is dative.

Line 52—54. *I stay too long*, &c.—Laertes appears to bethink him that he should have gone before; the thought is possibly suggested by the tone of Ophelia's advice, possibly by the coming of his father, whose blessing he has already received at a previous leave-taking.

Line 56. *The wind sits*—An expression often used with reference to the direction of the wind.

Line 59. *See thou character*—take care to inscribe. 'Character' is used as a transitive verb, and is accented on the second syllable. 'Characters' as a noun often means letters used in writing or printing.

Line 60. *Nor any unproportion'd thought his act*—and do not carry into action any unsuitable or ill-considered thought. 'His,' used for 'its.'

Line 61. *by no means vulgar*—not over familiar, do not make yourself too common. Latin *vulgaris*, common.

Line 62. *And their adoption tried*—and whose adoption thou hast tried. One suggestion is 'their adoption having been tried'—an instance of the absolute case.

Lines 64—65. *Do not dull thy palm*, &c.—do not make thy palm callous by shaking every man's hand. 'Comrade' is accented on second syllable.

Line 66. *Bear't that the opposer*, &c.—so conduct yourself in it that your opponent may fear you.

Line 69. *Censure*—opinion.

Lines 70—74. *Costly thy habit*, &c.—Let your dress be as expensive as you can afford, but not fanciful or striking in appearance. Let it be really good, not merely fine-looking; for dress often indicates character, and the higher classes of French people are especially marked by their good taste and liberality in that matter. 'Are of a most select and generous chief in that,' appears to be a corrupt line. Staunton suggests 'sheaf' for 'chief,' with the meaning *set* or *class*. Collier suggested 'choice' for 'chief,' and this seems more reasonable; but Rowe's omission of the words 'of a' seems still more reasonable, and a further improvement appears in the conjecture of the editors of the Cambridge Shakespeare, 'Are most select and generous in that.'

Line 77. *borrowing dulls the edge of husbandry*—The habit of borrowing tends to make people less careful and thrifty; 'dulls' makes less keen; 'husbandry,' economy. Compare the verb 'to husband,' and the phrase 'to husband one's resources.'

Line 79. *It must follow, as the night the day*—The prominent idea here is the certainty of the succession of night to day. This succession, however, is a natural sequence, but not a necessary consequence, which is the relation Polonius seems to assert as existing between truth to others and truth to oneself.

Line 81. *season*, ripen or temper. Compare the expression 'seasoned timber.'

Line 83. *your servants tend*,—Your servants are waiting for you.

Line 90. *Marry, well bethought*,—An interjectional line, containing only three accents. 'Marry' is an old exclamation meaning 'By the Virgin Mary.' 'Bethought' means remembered, called to mind.

Line 94. *'tis put on me*,—It is impressed upon me.

Lines 99—109. *many tenders*,—Professions. *Of his affection for me*. A line of four accents, *affection* being treated as a word of four syllables.

A green girl, Unsifted in such perilous circumstance. A girl who lacks that ripe judgment which comes only from experience in the dangerous ways of the world.

these tenders,—Promises to pay, like paper money.

not sterling,—Not genuine money. 'Sterling' is corrupted from *Easterling*, the name formerly applied in England to the traders of the Hanse towns, whose money was most valued for its pure quality. Hence 'sterling' came to be used for the English penny, which constituted the legal tender for all payments in this country.

Tender yoursely more dearly,—Have greater regard for yourself.

to crack the wind of the poor phrase running it thus,—To run the poor phrase out of breath by this constant use of it. This is in allusion to the laboured play upon the word 'tender' in which Polonius indulges.

tender me a fool,—Make a fool of me.

importun'd me with love,—Urged his suit upon me in an unresting, troublesome way. 'Importun'd' is accented here on the second syllable; it is derived from the Latin *in*, not, and *portus*, a harbour, through the French *importuner;* the root idea of the word is that of unrest and unsatisfied hopes, as of a ship tossing about with no harbour to make for.

Line 112. *Ay, fashion you may call it; go to.* 'Fashion,' from French *façon*, a mode or way, is here twisted by Polonius to mean changing mode, a passing fancy. '*Go to*' is a contemptuous exclamation in which 'go' is used simply as a verb of motion in general, and 'to' is used adverbially. Thus the literal meaning of the phrase is something like the more modern 'get along.' Abbott says it is almost equivalent to our use of 'Come, come.'

Line 113. *given countenance to his speech.* 'Countenance' here implies sanction or confirmation; compare our use of the word 'countenance' as a verb.

Line 115. *Springes to catch woodcocks.* A 'springe' is a snare with a spring noose. 'Wood-cocks' were supposed to be brainless, hence the phrase means 'snares for silly birds or simpletons.'

Line 116. *prodigal.* Used for 'prodigally,' one of the many instances where Shakespeare uses the adjective for the adverb.

Line 118. *extinct in both,*—Failing in both light and heat.

Line 119. *a-making,*—On making, for in the act of making. The prefix *a* for on was very commonly used with the participle in old English, and is still common in provincial dialects.

Line 121. *be something scanter,*—Be somewhat more chary.

Line 122. *Set your entreatments, &c.* Do not regard the invitations you receive from Hamlet as if they were commands you must obey. 'Entreatments' does not occur elsewhere in Shakespeare.

Line 126. *in few,*—In a few words, in short.

Lines 127—130. *for they are brokers, &c.* His vows are but go-betweens, their true colour is not what appears from the words in which they are clothed, they are only solicitors of dishonourable relations, whispering desires for sacred rites and holy ties, in order to deceive the more easily. Staunton strongly supports the old reading of 'bonds' rather than Theobald's alteration to bawds, for which indeed there seems no sufficient reason.

Line 133. *so slander any moment leisure,*—So disgrace a moment's leisure, the inflection denoting the possessive case was often omitted by early writers. The Clarendon edition regards 'moment' as an adjective, but in some sense every possessive is an adjective.

No thinking student can fail to notice the sententious manner of Polonius in his advice to Laertes. It is almost entirely good worldly advice, but, while given with so marked a tone of importance, the precepts are of a commonplace character and the wisdom of the second-hand sort. It may be worth while to contrast the natural, brotherly, and rather sympathising advice of Laertes to Ophelia, with the less kindly, the less delicate, and more overbearing remarks of Polonius on the same subject.

Scene IV. Coleridge calls attention to the subtle acquaintance with human nature which Shakespeare shows in the opening of this striking scene with commonplace remarks on the coldness of the night, and the striking of the clock, and also to the dramatic skill with which the mind of the audience is interested in comments on the evil results of national drinking customs so that the appearance of the ghost has all the more startling effect from the preoccupation of the witnesses.

Line 1. *Shrewdly,*—Piercingly. The root idea of this word, from *shrew*, a brawling or scolding woman, is rather one of moral bitterness than physical. A secondary and commoner meaning of 'shrewd' is mentally keen, or acute. Here we have a still further extension of the idea to physical sharpness.

Line 2. *eager,*—Sharp, keen, from Latin *acer*, through old French *eigre*. This again is an example of a word used with a physical meaning, which in modern use is more often applied to mental or moral feelings.

Line 3. *hour* is here a dissyllable, as 'fire' in line 120 of previous scene.

Lines 8—12. *The King doth wake to-night,* &c. The king is engaged in late feasting, he takes his deep draughts of wine, leads the boisterous drinking of healths, and joins in the wild dance of the revellers. And while he empties bumpers of Rhenish the sound of drums and trumpets celebrates the glory of his carousal. 'Wake' is the noun used as a verb, 'wake' meant a night feast: it is applied to village feasts to celebrate the dedication of the parish church. At first this was celebrated by sitting up all night and watching, hence the word from Anglo-Saxon *wacan*, to watch. '*Wassail*' is from A.S. *waes hael*, be of health.

up-spring is the name of a wild German dance, with which drinking parties closed a night of revelry. Pope and some others have supposed 'upspring' to be equivalent to 'upstart,' and applied it to the king with a reference to his having sprung up suddenly into power by his usurpation of the throne. Staunton appears to regard 'upspring reels' as a phrase in which 'reels' represents dances in which hands are joined, and 'upspring' is used attributively to indicate the wild character of the dances. Meiklejohn suggests that 'reels' is a transitive verb with 'upspring' for object.

'*Rhenish*' is the wine produced on the banks of the Rhine between Bonn and Bingen.

triumph is used ironically.

Lines 15—38. *It is a custom more honoured in the breach, &c.* The Danish drinking customs have been already referred to. Excessive drinking was a great failing of the Danes, and in Shakespeare's time it was a common fault of the English. So in this speech the poet probably intended to reflect upon the drinking habits of his countrymen.

breach,—Departing from it. Noun from *break*.

traduc'd and tax'd,—Slandered and censured.

clepe,—Call, from A. S. *cleopian*. The old passive participle *yclept* is also used.

with swinish phrase,—Comparing us to swine. The Clarendon editors wonder whether any pun is intended upon *Sweyn*, the name of several Danish kings.

Soil our addition,—Stain our title. 'Addition' means the descriptive title added to a person's name.

Achievements,—Principal exploits, from Fr. *achever,* from *chef,* head.

at height,—At our best.

pith and marrow of our attribute,—The very essence, the best part of our reputation.

mole of nature,—Natural blemish.

o'ergrowth of some complexion,—Development of some natural temperament beyond the power of reason to control. The old physicians recognised four complexions or temperaments—the sanguine, the melancholic, the phlegmatic, and the choleric. The word 'complexion' is pronounced as four syllables.

o'erleavens,—Sours or embitters.

plausive manners. Pleasing or popular manners.

nature's livery or fortune's star,—Some mark or defect of natural or accidental origin. 'Livery' is from Fr. *livré,* given; *livrer,* to deliver. *Star* is a spot which may be in the shape of a star; the term is used by farriers. There may also be a reference to astrological influence.

Their virtues else, &c. Whatever other virtues they may have, though they be as pure as grace is, and as large as man may be able to bear, the general opinion will regard them as spoiled and polluted by the one particular fault.

dram of eale—scandal.—The small portion of evil often does away with all the qualities of true nobility and disgraces it. This passage is undoubtedly corrupt. As many as forty-seven different conjectures have been made to correct the text. 'Eale' probably means evil; some say from an archaic spelling for *e'il,* others a printer's mistake for *base.* For 'of a doubt,' one would read 'derogate,' another 'soil with doubt,' another 'overcloud,' another 'oft debase.' Staunton suggests 'The dram of base doth (doeth, worketh) all the noble substance of a pound, to its own vileness,' on the ground that some such antithesis seems to be intended. 'Often doubt,' and 'often dout' (that is, do out or put out) are other plausible conjectures. The context shows sufficiently what is the intended meaning in general; the particular words to express it must be a matter of individual opinion or taste.

It is interesting to know that in two books of Shakespeare's time, one, 'The Plain Man's Pathway to Heaven,' by Arthur Dent, 1590, and the other, 'Pierce Penniless's Supplication to the Devil,' by Nash, 1592, passages are found similar to these reflections of Hamlet. As the second bears specially on the vice referred to in the play, we venture to quote it. 'A mightie deformer of men's manners and features is this unnecessary vice of all others. Let him bee indued with never so manie vertues, and have as much goodly proportion and favour as Nature can bestow upon a man, yet if hee be thirstie after his owne destruction, and hath no joy nor comfort, but when he is drowning his soule in a gallon pot, that one beastly imperfection wil utterly obscure all that is commendable in him, and all his goode qualities sinke like lead downe to the bottome of ais harrowsing cups, where they will lye, like lees and dregges, dead and unregarded of any man.'

Line 40. *spirit of health,*—A spirit saved or healed. *goblin,* an evil spirit, from Fr. *goblin,* low Latin *gobelinus,* Greek κοβαλος, a mischievous spirit.

Line 42. *intents,*—Intentions.

Line 43. *questionable,*—Able to be questioned, perhaps willing to be questioned. In *As You Like It* the word 'unquestionable' is similarly applied to a spirit that may not be questioned.

Line 47. *Why thy canonized bones, hearsed in death, Have burst their cerements,*—Why thy body made sacred by the rites of burial, buried in the tomb, have escaped from the shroud. 'Cerements' is from the Latin *cera,* wax, from the old practice of using a waxed cloth for a shroud. The word 'cere cloth' occurs in the *Merchant of Venice.*

Line 48. *inurn'd,*—interred, 'urn' being often used symbolically for grave.

Line 52. *complete.* Accented on the first syllable. Dr. Schmidt has remarked that this is always the case in Shakespeare where the word is used attributively, but that the accent is on the second syllable when it is used predicatively.

Line 53. *Revisit'st thus the glimpses of the moon,*—Comest back again to the earth when it is lighted by the glimmering of the moonlight. 'Glimpse' is from *gleam.*

Line 54. *We fools of nature,*—Us who are made fools of by nature; that is natural influences deceive us. 'We' is used for 'us.'

Line 55. *disposition,*—Constitution.

Line 56. *reaches.*—Plural of an abstract noun where we should nse the singular, compare 'your loves' 'your better wisdoms' already dealt with in Scene 2.

Line 59. *impartment,*—Communication, something to impart, only instance of the word, like 'condolement.'

Line 61. *It waves you to a more removèd ground,*—It beckons you to a spot more remote, or more retired.

Line 64. *should be* relates to the opinion of the hearer.

Line 65. *Set my life at a pin's fee,*—Value my life at the worth of a pin. 'Fee' meant first *cattle,* then *money,* then *estate,* or property, like Latin *pecus,* cattle, the root of *pecuniary.*

Line 71. *beetles o'er his base,*—Overhangs its base. The expression 'beetle brows' means overhanging brows.

Line 73. *deprive your sovereignty of reason,*—Take away the power of control exercised by your reason: 'deprive' here takes the accusative of the thing not of the person as it usually does, and 'sovereignty of reason' is the object.

Line 75. *toys of desperation,*—Idle fancies of despair.

Line 83. *Nemean lion's nerve.* The Nemean lion was a great lion killed by Hercules, and was so named from Nemēa, a rock in Argolis near which the lion was slain. The rhythm requires the accent to be on the first syllable of Nemean, though it is usually on the second. 'Nerve' is used for 'muscle.'

Line 85. *I'll make a ghost of him that lets me.*—I will slay him that hinders me. 'Let,' to hinder, is cognate with *late* and *lazy.* Compare 'without let or hindrance.'

Line 89. *Have after,*—Let us go after him.

(To be continued.)

—o—

THE SONG OF THE BROOK.

Legato.
mf.
1st TREBLE.
2nd TREBLE.
BASS.
1. What was the song of the mea - dow brook, As un - der the wil - lows his
2. Dais - ies that shine bright - ly oe'r my side, Ye beau - ti - ful dais - ies bright
KEY G. mf. Legato.
way he took? Would-n't you like to know? ..... Oh! let me play a -
star - ry - eyed, Kiss me, for I must go! ..... And now I go to
D. f
p
while as I will And by and by I must turn the mill As
turn round the wheel And grind the corn in - to powd' - ry meal And
cres.
f
far - ther down I go, As far - ther down I go. .....
drifts of gold - en snow, And drifts of gold - en snow. .....
f

Knitting Maps.

BY MRS. J. D. HARRIS.

SOCK FOR CHILD OF TWO YEARS OLD.

This pattern will answer up to three and a-half years, if the size of the pins is increased, and the foot lengthened.

Pins No. 21. Chamber's bell guage.

1 oz. of Andalusian wool or knitting silk.

Cast on 20, 20, 16—56 stitches in all.

Knit 1, purl 1, for two inches.

A. In the back pin, knit 10, take up a stitch and purl it. This is the seam stitch, which must be purled in every round.

Knit 4½ inches.

To Knit the Heel.

B. Put 14 stitches each side of the seam stitch on one pin, and 14 stitches on each instep pin. Knit and purl the alternate rows of the heel pin, being careful to slip the first stitch of each row, and also remembering to *purl* the stem stitch on the reverse side.

C. When you have 6 loops on each side, knit 12, slip 1, knit 1, put the slipped stitch over. Seam 1, knit 2 together.* Knit the rest of the row. Purl back, repeat these reducings twice more, always on the right side.

D. Knit to the seam stitch. Put the 28 instep stitches on one pin, and the seam stitch on a pin, which will now be the first heel pin. Turn the two heel pins together on the right side. Knit together, and cast off. (This must be done rather loosely, otherwise there will be a hard ridge under the foot.)

E. First heel pin. Take up 9 loops, and add 2 stitches from the instep pin. Knit the remaining stitches, all but the 2 last. Knit these on the 2nd heel pin, and take up 10 loops. You will have to *sneak* one stitch in, which is best done at the end of the row.)

Knit 2 plain rounds.

To reduce for Instep.

F. First heel pin. Knit to within 4 of the end. Knit 2 together.

Second heel pin. Knit 2, skip 1, knit 1. Put skipped stitch over. Knit 2½ inches, or longer if required.

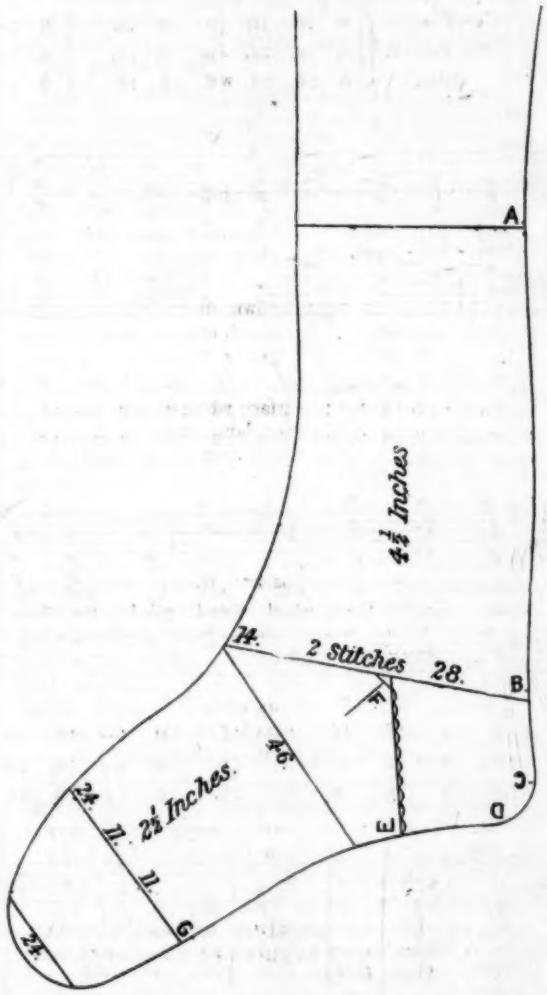
To reduce for Toe.

G. Put 24 stitches on the front pin, 11 on each heel pin.

First heel pin. Knit the last stitch of this pin and the first of the next pin together, and the last stitch of the instep pin and the first of the second heel pin together.

Knit 1 round between each reducing.

When only 24 stitches left, knit together and cast off.



(To be continued.)

Notes of a Lesson on Dew and Snow.

BY JOSEPH H. COWHAM, F.G.S.,

Lecturer on School Method: Westminster Training College.

INFORMATION ARRANGED IN TEACHING ORDER.

A. Dew.

Obvious and familiar facts.

At night, when the sun has set, after a warm day, the grass becomes wet. On the following morning drops of water hang from the blades of grass and the leaves of trees. **This form of moisture is called Dew.**

Explanation of the phenomena.

(*a*) *Experiments—*

1. It has been shown in the lesson upon 'Clouds' that 'moisture is always present in the air in the form of aqueous vapour.'

2. A very cold surface when exposed to the air soon becomes damp with this moisture which it condenses from the atmosphere.

(*b*) *Application to the formation of Dew.*

1. Blades of grass and leaves of trees are good radiators of heat, partly on account of the large proportion of surface they possess.

2. After the sun has ceased to shine these rapidly become cooled by radiation and in turn chill the air in contact with them.

3. The air thus cooled soon reaches the temperature at which moisture begins to be deposited upon the cold surfaces of the grass and leaves.

4. **The temperature at which moisture thus begins to collect is called Dew Point.**

(*c*) **Nights which are unfavourable for the formation of dew.**

1. When clouds cover the sky they prevent the rapid cooling of bodies near the earth's surface by radiation and thus they hinder the formation of dew.

ILLUSTRATIONS AND TEACHING HINTS.

Introduce by recalling a walk across a field of grass on an evening in the autumn, and by reference to the drops of dew shining on the hedgerows in the early morning.

Fig. 1. Glass of water containing iced water with moisture condensing upon its surface.

Show this familiar appearance, and refer to previous experiments of the same kind, in order to show that the moisture in the atmosphere can at all times be rendered visible. Hence :—

1. Moisture is always present in the air.

2. A cold surface will reveal it.

1. This fact must be told; at the same time exhibit a blade of grass, in order to show its large surface area.

2. This is an inference from the fact just stated.

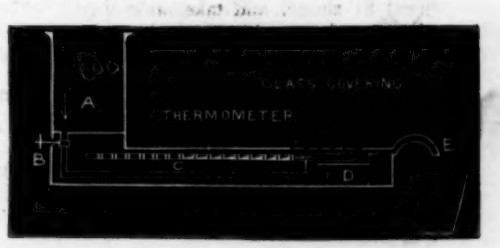


Fig. 2. Arrangement by Mr. Dines for showing dew-point.

Turn on the ice-cold water by means of the tap B; it flows along the tube C, over the bulb of the thermometer at D, and under the glass covering; as soon as the moisture dims this glass the observer reads the thermometer. This reading is the *dew point.*

Refer to the state of the grass under a wide-spreading tree on a night when dew is found heavily deposited on the other portion of the field. What causes the absence of dew under the tree?

In answer, if a thermometer were placed on the grass beneath

2. When a strong breeze is blowing, the air does not remain in contact with the cold surface of leaves, &c., sufficiently long to have its moisture condensed and dew formed.

What is dew?

Dew is the moisture which collects on grass, on leaves, and on other bodies near the earth's surface in consequence of the cooling of these substances during the night by radiation.

B. Hoar-frost.

When the cooled surface upon which the moisture is deposited is reduced in temperature below *freezing point*, then instead of dew we find little spikes of ice.

These icy particles which whiten the grass and branches of trees during a frosty night are called 'Hoar-frost.'

C. Snow.

1. The snow which falls from the clouds in winter is formed under conditions very similar to those under which hoar-frost is formed.

2. The air during this season is frequently at or below freezing point, and should moisture then be condensed from the atmosphere it is condensed in the form of snow.

3. The snow particles are very beautiful in shape. They assume tiny hexagonal forms like those drawn in Fig 4.

These regular forms are water crystals.

4. When a number of these crystals join together and fall to the earth they are called **'Snow-flakes.'**

D. Hail.

Contrast between Hail and Snow.

Hail.	Snow.
1. Falls chiefly in summer.	1. Falls in winter.
2. In appearance like little pellets united together and called 'Hail-stones.'	2. Exhibits beautiful crystal bodies which when united form 'Snow-flakes.'
3. Frozen after being formed into globules of water and then united into stones of varying sizes.	3. Formed directly from the condensed vapour without passing through the globular form.

the tree, it would not, during the early part of the evening, register so low a temperature as the one on the grass under the clear sky. Hence *the tree keeps the grass from radiating its heat.* Similarly, the clouds overhead prevent radiation and hence hinder the formation of dew.

2. State this fact and show by placing the glass of iced water in a draught.

This answer might be obtained in full from some of the class able to gather up the chief truths taught about dew.

Fig. 3. Showing formation of hoar frost upon the outside of a black tray filled with ice and salt.

By means of this experiment actual hoar frost may be shown to the class in the middle of summer.

N.B.—Wipe off the moisture which forms at first on the sides of the vessel; when the sides are reduced below freezing, the little spikes of ice, forming hoar frost, will collect and whiten the sides.

The formation of snow may be inferred from the mode in which hoar frost is formed.

Fig. 4. Collection of snow crystals.

3. Draw figures similar to the above on the black board. The children should also attempt to draw them.

Simple notions of a crystal may here be taught, as, *e.g.*,

Regularity of shape formed by non-living matter.

4. These should be pointed out during a fall of snow.

1. The scholars may be led to make this contrast by reference to their own experience.

2. Show diagram of hailstone, and contrast with snow crystals Fig. 4.

3. An inference supported chiefly by the difference of form exhibited by hailstone and snow crystal respectively.

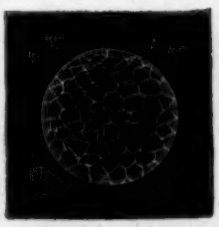


Fig. 5. Diagram of Hailstone.

BLACKBOARD SKETCH.

1. **Dew** is moisture condensed from the air upon the cold surfaces of bodies which rapidly radiate heat after sunset.
2. **Dew Point** is the temperature to which air is reduced in order that its moisture may begin to be deposited.

NOTE.—Cloudy and windy nights are unfavourable to the formation of dew.

3. **Hoar Frost** is frozen moisture condensed upon the surface of bodies whose temperature is reduced to or below freezing point.
4. **Snow** is formed when the moisture in a cloud is condensed in air reduced to or below the freezing point.
5. The particles of snow are beautifully regular forms, hexagonal in shape, and are called water-crystals.
6. **Hail** is common in summer. Each hailstone is formed of frozen globules of water united together.

Matriculation Hints.

BY H. A. REATCHLOUS, M.A. (LOND.), B.SC.
Westminster Training College.

ON a previous occasion several articles were published in this journal with a view of helping those who were anxious to pass the Matriculation Examination of the London University.

New regulations have been recently issued which contain changes of great importance. These regulations will come into force in June 1888. Candidates will do well therefore to consider the new requirements at once. There is no change in regard to Latin. The advice which we offered before is equally applicable now. There will still be two papers in the subject, which will occupy four hours and bring 400 marks.

Formerly, beside Latin, every candidate had to show a competent knowledge in any two of the following languages: (*a*) Greek; (*b*) French; (*c*) German; (*d*) Sanskrit or Arabic. It will now be sufficient to show competence in one of them. This is a great innovation. It amounts to reducing the requirements by the knowledge of a language. There can be no doubt that this concession will make the preparation much easier and will most likely lead to a considerable increase in the number of candidates.

Considering the difficulties of a language like Greek, and the time it takes to acquire even the elements of it, those who mean to present themselves for examination in it at a later stage will do wisely to select it for Matriculation. But there is an increasing number of candidates who learn as much Greek as will enable them to Matriculate and then cast it aside. This is the case with many who are anxious to secure a degree in Science in Law or in Medicine. The impression has been growing for a long time and is now almost universal that it would have been much better if the time thus devoted to Greek had been spent in learning German. German is the most useful modern language a student can learn. For the science student it may be said to be indispensable. It is likely that the advantage of knowing it will rather increase than diminish during the next fifty years. We advise all those who do not take up Greek to study French and German. There ought not to be any difficulty in learning both.

The only important change in the new regulations relating to English is in Geography. Formerly the requirements specified the English Language, English History, and Modern Geography. Instead of Modern Geography we now have English History with the Geography relating thereto. This is a very different thing and a much easier one. The note laying stress on correct spelling and grammar in the answers to the questions is new, and should be specially borne in mind. Good composition, neat writing and correct spelling will carry more weight than before with the examiners.

The alterations in Mathematics are few. In Arithmetic proportion is not now specially named; it was before; but proportion is expressly mentioned in Algebra, while quadratic equations are omitted. Arithmetical and Geometrical progression remain as before. The present requirements in Euclid are the first four books and simple deductions. Though deductions were not specially mentioned in former years it has always been the practice to set them, and very properly so.

One of the novelties of the new Syllabus is the introduction of 'Mechanics' as a compulsory subject. As a basis for the study of Physics, Mechanics is essential, and there can be no doubt that the Senate have acted wisely in making certain parts of it necessary for a pass. Previously parts of it were included under the head of Natural Philosophy. It will now reckon as a separate subject, and will carry as many marks as Geometry or French. The subjects to be studied have been selected with great judgment. It is easy to see that the importance of Dynamics is realised. The propositions relating to liquids and gases have been copied from the former Syllabus without much change. The present regulations stand as follows:—

MECHANICS.

Elementary notions as to Velocity, Acceleration, Force, Mass, Momentum, Work, and Energy.

Composition and Resolution of Velocities, Accelerations, and Forces, in one plane.

Moments and Couples, in one plane.

Centre of Gravity, or Mass-centre.

Transmission of Pressure in Liquids; variation with depth of the pressure due to weight of liquids.

Specific Gravity, and modes of determining it. Pressure of gases and laws relating thereto.

Atmospheric pressure.

Common instruments and apparatus whose action depends upon the pressure of liquids, or of the atmosphere, or of both.

The candidate has then the option of taking one of the following branches of experimental science—(1) Chemistry, (2) Heat and Light, (3) Magnetism and Electricity.

The Chemistry is pretty much as it was before. There are one or two trifling omissions, but there is no change of importance. As the subjects of Light and Heat will form a separate paper, it must be expected that candidates will not be allowed to pass unless they show that they have a fairly accurate acquaintance with them. The same remark applies to the paper on Magnetism and Electricity. The regulations for these two subjects are appended.

II. HEAT AND LIGHT.

Heat.—Expansion of Solids, Liquids, and Gases accompanying rise of Temperature: laws relating thereto. Thermometry. Calorimetry. Specific heat. Liquefaction and solidification. Vaporization and condensation; ebullition; properties of vapours, saturated or unsaturated. Latent heat. Transmission of heat by conduction and convection.

Light.—Propagation of light in straight lines in uniform media. Velocity of light and modes of determining it. Intensity of light, its variation with distance. Shadows. Photometry. Reflection and Refraction at plane or spherical surfaces. Formation of Images by plane and spherical mirrors, and by simple lenses (excluding aberration). Decomposition of white light by a prism. The prismatic Spectrum.

III. MAGNETISM AND ELECTRICITY.

Magnetism.—Simple experimental properties of Magnets. Effect of a magnet on a neighbouring piece of soft iron or of hard steel. Terrestrial magnetism: behaviour of a declination needle and of a dipping needle at different parts of the earth's surface.

Electricity.—The two Electrical States and their mutual relations. Attraction and Repulsion. Conduction and Insulation. Electrostatic Induction. The common plate and cylinder electrical machines. Electrical condensers. Distribution of electricity upon conductors. Current electricity. Common forms of battery. Ohm's law and its simple applications. Heating, chemical, and magnetic effects of electric currents. Simple experimental methods of generating currents by relative motion of conductors and magnets. The simple laws of magneto-electric induction.

The examinations will be conducted in the following order:—

MONDAY.

Afternoon, 2 *to* 4.	Latin.
4 *to* 6.	Latin Grammar & Composition.

TUESDAY.

Morning, 10 *to* 1.	Greek, French, German, Sanskrit, or Arabic.
Afternoon, 2 *to* 5.	Arithmetic and Algebra.

WEDNESDAY.

Morning, 10 *to* 1.	Geometry.
Afternoon, 2 *to* 5.	Chemistry; or Heat and Light; or Magnetism and Electricity.

THURSDAY.

Morning, 10 *to* 1.	English Language.
Afternoon, 2 *to* 5.	English History, with the Geography relating thereto.

FRIDAY.

Morning, 10 *to* 1.	Mechanics.

The full number of marks now obtainable is 2,500. Of these 1,900 qualify for a prize, 1,700 for honours, 1,300 for the first division. There is no regulation fixing the number of marks for a pass. In a second paper we shall try to name some books and give some advice which may prove useful to those who are preparing for the Matriculation Examination under the new regulations.

(To be continued.)

—o—

Science Notes.

THE annual examinations of the Science and Art Department are over for another year. By and by a report upon the work sent in will be published, and both teachers and taught may then gather some useful lessons from the criticisms of the eminent men who set the questions, and are responsible for the examinations. Most of those who have been recently examined will need a rest. They had better take it. But it should not be too prolonged. After a short time it will be better to seek rest in a change of work, in a new interest, in a fresh object of study. This advice is specially applicable to candidates who have passed in the elementary stage and mean to proceed to the advanced stage next year, especially if they have taken up subjects like Botany, Biology, or Chemistry. Botany can only be profitably studied by constant reference to actual specimens, and in many cases these can only be obtained in the summer time. The next three months are the botanist's harvest time. Field excursion parties should be organised for the collection, identification and preservation of specimens. Every teacher would only be too willing to name suitable books and apparatus for the work. It is much the same with Biology. The actual dissection of specimens is slow work, and on the whole the more profitable the slower it is done. Long days, abundance of light, facilities for obtaining specimens, all point to the undesirability of allowing the summer months to pass by unused.

***

WE learn from *Nature* that many of the beautiful Alpine flowers, especially the edelweiss and the Alpine rose, are in danger of becoming extinct. Tourists think it the right thing to do to bring large specimens of these flowers home. The Government of Valais, and the Monte Rosa section of the Alpine Club, have had gardens laid out for the growth and preservation of these plants. One of these gardens, at a height of nearly 8,000 feet, cultivates not only plants belonging to the Alps, but also plants from the Himalayas and the Caucasus.

STUDENTS of Chemistry who do not read German, and we fear they still form the majority, will not fail to notice that Messrs. Longman and Co. have promised an English translation of *Lothar Meyer's* 'Modernen Theorien der Chemie.' This will be a great boon to all who have not been able to peruse the original. It is not creditable to us that the book has not appeared in English long ago. Why don't the English Professors keep us informed of all that is best in the foreign literature of their subjects. It would not then be so easy for them to set questions which so few candidates can satisfactorily answer.

***

THE artificial imitation of the colours of the setting sun is a very beautiful lecture experiment, due to Captain Abney. Light from a lime light or from an electric arc is passed through a cell containing a solution of sodium hypo-sulphite. A little hydrochloric acid is added and the sulphur is deposited in very fine particles which scatter the light at the blue end of the spectrum. The transmitted light thus becomes redder and effects similar to those of the setting sun are produced. This affords a pretty satisfactory explanation of the resplendent colours of the setting sun.

***

THERE are two important bills before Parliament in regard to higher Elementary Education. It is not likely that they will receive immediate attention but they are important both in themselves and in the direction to which they tend. The first is a bill introduced by Sir Henry Roscoe, empowering any School Board, local authority, or managers of a public elementary school to provide day technical and commercial schools and classes. The other bill has been introduced by Professor Stuart for the establishment of evening schools and classes which shall give instruction in continuation of that obtained in public elementary schools. The subjects to be taught are such portions of science as may be useful to artizans and agricultural labourers. These schools and classes will be subject to the inspection of the Education Department or of the Science and Art Department. Those who attend them must have passed the 4th or 6th Standard according to circumstances. The funds for carrying these classes on will be provided mainly by grants from the council office and Science and Art Department, but also partly from fees and rates.

***

AN interesting and instructive correspondence has been going on in *Nature* for some time on the units of weight and mass. One point comes out very clearly, how undesirable it is to call two entirely different things by the same name, and then expect people will not confuse them. The mass of a body, says Maxwell—that is, the quantity of matter it contains—is of course invariable, but the weight stricty so called—that is the tendency of the body to move downwards—is not invariable, for it depends upon the part of the world where it is placed, its weight being greater at the pole than at the equator, and greater at the bottom of a coal mine than on the level of the sea. The practical issue of the discussion will be to give increased impetus to the desire for names for all mechanical units.

Students see how much electricity has gained in ease and clearness of exposition since the adoption of the received names for the units now employed. We may be sure that we shall not much longer be left without names for important quantities like the unit of velocity, of acceleration, and of impulse. Already we find that, without waiting for a general agreement, teachers have imposed provisional names of their own. Perhaps the most advanced and successful effort is in Mr. Lock's new book 'Dynamics for Beginners.' We hope a general agreement may soon be arrived at, meantime we heartily thank Mr. Lock and wish his admirable book a very wide circulation.

—o—

Publications Received.

Bell, G., and Sons—
Easy Latin Passages for Unseen Translation. By A. M. M. Stedman, M.A.

Blackie and Son—
The Gospel of St. Luke. Part II. By Dr. Lindsay.
Scott's Lady of the Lake.
Gray's Elegy, and other Poems.
What and How. By T. Hassell.

Cassell and Co., Limited—
Cassell's Combination Test Cards. Standards II. to VII.

Chambers, W. and R.—
Shipwrecks and Tales of the Sea.

Chapman and Hall—
Science and Art. June.

Curwen, J., and Son—
School Cantata: The Holiday Concert. By J. O. Murdoch.

Fisher Unwin, T.—
The Story of the Nations: Ancient Egypt. By Prof. G. Rawlinson.
English as She is Taught.

Heywood, John—
Fifty Examinations in Mental Arithmetic. Standards I. to VII.

Hodder and Stoughton—
The People's A B C Guide to Health. By W. Gordon Stables, M.D., R.N.

Longmans and Co.—
Boys and Masters. By A. H. Gilkes, M.A.
Wild Animals of the Bible. } By the Rev. J. G. Wood,
Domestic Animals of the Bible. } M.A.

Marcus Ward & Co.—
The Oriel Geographical Reader. Standard V.

Nutt, David—
A Short German Accidence and Minor Syntax. By H. W. Eve, M.A.

Philip, G., and Son—
Philip's Handy Volume Atlas of the World.

Simpkin, Marshall & Co.—
The Victoria Jubilee Algebraic Tests. Stages 1, 2 and 3.

Smith, Elder and Co.—
The Cornhill Magazine. June and July.

The Cambridge University Press—
Lectures on the teaching of Modern Languages in Theory and Practice. By C. Colbeck, M.A.

Williams and Norgate—
Petit Vocabulaire. By H. E. Schmidt, Ph.D.

Publications Reviewed.

Algebraic Tests. London: Simpkin, Marshall and Co.

We accord a hearty welcome to these carefully prepared tests in Algebra. They are adapted to Stages I., II., and III. of Schedule 4, and the whole course covers the requirements of the Mathematics (Stage I.) of the Science and Art Department. The 'Mental Drill' which appears in each of the three little books is a specially valuable feature. When we add that the price is extremely moderate, our readers on the outlook for a new elementary Algebra will see that they cannot do better than get the one now before us.

Jubilee Portrait of Queen Victoria. London: A. Johnston & Co.

This is an admirable likeness of Her Majesty, printed in colours, and suitable for hanging on school-walls. It is issued in various forms to suit all tastes, and should command a wide circulation.

Manchester Tracts on Education, No. I. By James A. Newbold, B.A. London: John Heywood.

Without entering into the vexed question as to whether all our schools should be free or not, we are bound to state that Mr. Newbold in his able pamphlet proves beyond the shadow of a doubt that the case of the Manchester Free School is no argument for Universal free schools. The author's bitterest opponent cannot but admire the spirit in which Mr. Newbold writes, and we ourselves beg to congratulate him on the general excellence of his work.

Second Grade Perspective. By George Oscar Blacker. Manchester and London: John Heywood.

Mr. Blacker has had considerable experience in teaching perspective, and has issued this work in twelve numbers, combining an exercise and text book of theoretical and practical perspective. The work of Dr. Brook Taylor has been closely followed, and we can speak favourably of the first five books of the series which have been forwarded to us. They contain the principal part of the theory of perspective and examples for practice in straight line figures. Many of the names in common use by teachers of perspective are discarded, and some of the definitions are uncommon, but the book is practical, and can be commended.

We are compelled to hold over the particulars of our Prize Scheme, 'Hints to Pupil Teachers,' by one of H.M. Inspectors, 'Easy Steps in Trigonometry,' by the Rev. A. D. Capel, M.A., 'The Musical Instrument (Violin) Maker of Cremona,' 'Christopher Columbus,' as well as a large number of Reviews.

The 'Practical Teacher' Sale and Exchange Column.

For Sale.—Sauer's Italian Conversation Grammar, equal to new, cost 5s. 6d., will sell for 2s. 9d.—Teacher, Willingham, Cambs.

EYRE AND SPOTTISWOODE,
THE QUEEN'S PRINTERS.

THREE MOST SUCCESSFUL BOOKS.

'THE QUEEN'S PRINTERS'
TEACHERS' BIBLE.'
The ORIGINAL,
FULLEST,
And BEST.
ELEVEN SIZES, from 3s.

'THE VARIORUM
TEACHER'S BIBLE.'
With Foot Notes
BY
CHEYNE, CLARKE, DRIVER, GOODWIN, and SANDAY.
From 7s. 6d.

'BARRY'S
TEACHER'S PRAYER-BOOK.'
By Dr. BARRY, Bishop of Sydney and Primate of Australia.
Prayer-Book and Notes interpaged throughout.
NEW EDITION, with Notes on the Psalter, by Bishop BARRY, and Glossary by MAYHEW.
Large type, 16 mo. ... ... from 6s. od.
Nonpareil type, 24 mo. ... ... ,, 3s. 6d.
School Edition (without Notes on Psalter and Glossary) ... ... ,, 2s. 6d.
The Bishop of CHICHESTER wrote:—'Canon Barry was of all others the most fitted and best qualified for such a task.'

The Sale of the above Books is so large, that Reprints are constantly being required.

Just Ready. An Edition upon Thin India Paper.
VARIORUM TEACHER'S BIBLE.
Nonpareil 8vo. (7¾ × 5½ × 1 *inches*) *1250 pages.*

THE VARIORUM NOTES serve as AN INDEX TO THE REVISERS' CHANGES in both Testaments, and for practical use combine a Revised with the Authorised Version.

'Gives, as nearly as possible, a correct idea of the meaning of the original text.'—*Saturday Review.*
'The footnotes "give the sense" of hundreds of passages more or less obscure, and save time and labour in referring to commentaries.'—*The Christian.*

Printed upon India paper of the finest texture, reducing the bulk of the volume, so that the 450 additional pages, comprising the 'Aids to Bible Students,' are included within the dimensions of a book no thicker than an ordinary Reference Bible.

The original 'VARIORUM TEACHER'S BIBLE' is most highly prized by those who use it. Where the well-known 'Revised Version' makes such references as 'Some ancient authorities read,' these ancient authorities are named in the above work.

The notes appeal at once to the ordinary Bible reader, whose chief difficulties they endeavour to meet, and to the special or professional student, who will find, it is hoped, particularly in the Old Testament, a more careful selection of critical data and authorities than is elsewhere accessible.

Prices of the New India Paper Edition—from 13s. 6d. to 35s.

EYRE AND SPOTTISWOODE, GREAT NEW STREET, FETTER LANE, LONDON, E.C.
RETAIL OF ALL BOOKSELLERS.

PUBLISHED BY BLACKIE & SON.

Just Published, Feap. 8vo, Cloth, 1s.

WHAT AND HOW:

A GUIDE TO SUCCESSFUL ORAL TEACHING.

By JOSEPH HASSELL, A.K.C., Lond.,
Author of 'Common Things,' 'Scripture Biography,' &c., formerly of the Home and Colonial Normal College.

This work is intended as a useful Text-book for Students in Training Colleges, Pupil Teachers, and Assistants in Elementary Schools.

Just Published, Crown 8vo, Cloth, 3s.

THE COMPREHENSIVE EXAMINER;

A TEACHERS' AID TO CLASS EXAMINATION.

Being a full Series of Questions on the principal subjects prescribed in the Code, together with Appendices on Parsing, Analysis, &c., and a selection of Themes for Composition. By DAVID CLARK, Head Master of the Board School, Pensnett, Dudley.

'The practical value of the collection is enhanced by the fact that a large proportion of the tests have been actually set by Her Majesty's Inspectors, while the reputation of the compiler as a rational educationist is a guarantee that attention has been paid to the educational value of the exercises. To teachers desirous of testing their classes by an independent and reliable standard, while saving their time and labour, this useful work will prove highly acceptable.'—*Schoolmaster.*

Just Published, Crown 8vo, Cloth, 1s.

EUCLID'S ELEMENTS OF GEOMETRY.

BOOK I. With Notes, Examples, and Exercises, arranged by A. E. LAYNG, M.A, Head Master of Stafford Grammar School; formerly Scholar of Sidney Sussex College, Cambridge.

In this edition of Euclid a system of arrangement has been adopted whereby the enunciation, figure, and proof of each proposition are all in view together, while the Notes and Exercises are directly appended to the propositions to which they refer.

*** The other Books of Euclid to follow.*

London: BLACKIE & SON, 49 & 50, Old Bailey.

W. & A. K. JOHNSTON'S RECENT PUBLICATIONS.

The Threepenny Atlas, New "Modern Series." 12 Quarto Full-Coloured Maps, in Wrapper.

The Colonial and Indian Atlas of the British Empire. 56 Full-Coloured Maps, with Historical Notes, etc. Large 8vo. Full-Bound Cloth, price 5s.

The Colonial Atlas of Oceania. 13 Full-Coloured Maps. Large 8vo. Stiff Boards, Cloth Back, price 1s. 6d.

Pupil Teachers' Geographical Year Books, New Series, with Full-Coloured Maps and Letterpress. 8vo. Full-Bound Cloth, price 2s. 6d. each. First Book—British Isles, British North America, etc. Fourth Book—America, West India Islands, etc. (Second and Third Books in preparation.)

Penny Maps of British North America and Asia Minor—Coloured, Projection, Outline, and Test.

The Howard Vincent Map of the British Empire, 72 X 63 in., on Cloth and Rollers, Varnished, with Handbook, price £1 1s.

Handbook to the Howard Vincent Map of the British Empire, with Small Coloured Map. Crown 8vo, price 3d.

Small School Wall Map of India, on Cloth and Rollers, Varnished, price 6s.

Small School Wall Map of Australia, on Cloth and Rollers, Varnished, price 6s.

CLASSICAL HISTORY CHARTS.—*READY.*

Chart of Ancient Greek History from the Earliest Times to the Conquest of Greece by the Romans, B.C. 146.

Chart of Roman History, No. 1, from the Earliest Times to the Battle of Actium, B.C. 31.

SHORTLY.

Chart of Roman History, No. 2, from the Battle of Actium to the Coronation of Charlemagne as Emperor of the West, B.C. 31 to A.D. 800.

Price of each Chart in Sheet, Coloured, 9d.; or 1s. on Cloth, folded, and in Tinted Cloth Case.

Illustrations of Chemistry—Sheet 5—Crystallization. Size, 50 X 42 inches. Price (with Handbook) 12s. on Cloth, Rollers, and Varnished. This Series is now complete.

For full details of W. & A. K. JOHNSTON'S Wall Maps, Wall Illustrations, Atlases, Terrestrial and Celestial Globes, Scientific Works, &c., &c., See their Catalogue, which is posted Gratis to any address.

W. & A. K. JOHNSTON,

Geographers to the Queen, Educational and General Publishers.

[*ESTABLISHED 1825.*]

EDINA WORKS, EASTER ROAD; & 10, SOUTH ST. ANDREW STREET, EDINBURGH;
5, WHITE HART STREET, WARWICK LANE, LONDON, E.C.

SCHOOL BOOKS,

For Students of All Ages.

DICTIONARIES OF THE BIBLE, AND CHRISTIAN ANTIQUITIES AND BIOGRAPHY: LATIN, CLASSICAL, BIOGRAPHICAL.

GRAMMARS. LATIN, GREEK, ENGLISH, FRENCH, GERMAN, HEBREW, AND ITALIAN.

HISTORIES OF ALL COUNTRIES AND AGES.

THE NEW ETON COLLEGE SERIES OF SCHOOL BOOKS.

MANUALS OF GEOGRAPHY, LITERATURE, PHILOSOPHY, COMPOSITION, SCIENCE, &C., FOR ADVANCED OR ELEMENTARY STUDENTS.

COMPOSITION AND EXERCISES IN ENGLISH, FRENCH, GERMAN, ITALIAN, LATIN, GREEK, AND HEBREW.

***** Catalogues, containing full descriptions of all these Works, with numerous illustrations, sent on application to the Publisher.**

JOHN MURRAY, ALBEMARLE STREET, LONDON.

UNIVERSITY CORRESPONDENCE COLLEGE

(With which the Intermediate Correspondence Classes are connected).

TUTORS.—**M.A.**—Classics and A.S. **M.A.**—Philosophy. **B.Sc.**—(Hons.) **M.B.**—(Hons.), Sub-Examiner of Lond. Univ. **B.A.**—(Lond.) Double Hons.—French and German. **M.A.**—Camb. and Lond. Wrangler. **M.A.**—Wrangler, late Examiner. **LL.B.**—First in First-Class Hons.

SYSTEM.—*Weekly* Schemes of Study, Notes, Hints, Vocabs, and at week end a Test Paper, *compiled from previous Exam. Papers,* and solution of difficulties. Most successful.

Single subjects, or full preparation for **MATRIC., INTER.,** and **FINAL B.A.,** at low fees, payable as arranged on joining.
Students for Intermediate Arts, 1888, are requested to join early.
Full particulars given on application to—

Prof. CLIVE, 54, Nelson Square, London, S.E.

BOOKS BY THE TUTORS.

INTERMEDIATE ARTS GUIDES (Price 1s). Contain Questions of last Exams., with full Solutions to Mathematics. No. 2 ready end of July.

'Full of that particular kind of information so needful to those about to undergo examination.'—*Teachers' Aid.*

'Really useful, nothing can be better for the student who intends to present himself next July.'—*School Guardian.*

'An excellent selection of Text Books.'—*Practical Teacher.*

MATRICULATION DIRECTORIES (Price 6d.). On same lines. No. 2 end of June.

'Come (like the Pickwick Pens) "as a boon and a blessing."'—*School.*

INTERMEDIATE MATHEMATICS (Price 2s.) contains Questions of last twelve Exams. and all Conics since 1840, Answers and Hints for Examination, Structure of Papers, &c.

'Of very special value to the student preparing for the Intermediate. Everything is "cut and dry" in the very best sense.'—*Educational News.*

MATRICULATION MATHEMATICS. Just Issued, Price 1s. 6d On same lines.

'An excellent daily companion for the candidate.'—*School Board Chronicle.*

B.A. MATHEMATICS (Pure). Price 2s. Contains Solutions to every Paper set at that Examination.

'The solutions are admirable, and cannot fail to be suggestive even to experienced mathematicians.'—*J. Teachers' Journal.*

Post free, for stated amounts, from Prof. CLIVE.

SECOND YEAR CERTIFICATE—DECEMBER.—Highly successful Coaching by Correspondence. No fee unless successful first time. Backward students made to pass. Exceptionally low terms.—Addressed envelope for particulars, list of successes, &c., George Henry Sparrow, Forest Gate, London, E.

N.B.—Acting Teachers who intend taking Papers of the Second Year are invited to communicate at an early date with Mr. Sparrow. The work for Second Year Students having been the speciality for the past five years, with increasing success each year, there is little fear of failure now. Dull Students are got through safely, and bright ones pushed into First Division.

ALBION COPY BOOKS.
ALBION EXERCISE BOOKS.
ALBION SCHOOL CERTIFICATES.
SCHOOLS SUPPLIED BY
THOMAS LAURIE,
LONDON SCHOLASTIC TRADING CO.,
28, PATERNOSTER ROW, LONDON.

CIVIL SERVICE EXAMINATIONS, ETC.—
Special Day, Evening, and Postal Classes, conducted by J. KEEFE, F.R.G.S., and T. BROSCOMBE, B.A., Cantab.
LIVERPOOL—22, GREAT GEORGE STREET.
MANCHESTER—5, VICTORIA STREET.
Assisted by First-Class Certificated and Trained Teachers, Members of H.M. Civil Service, etc. Over 250 Successes, including 35 Men Clerks, 39 Excise Assistants, 22 Boy Clerks, 15 P.O. Clerkships, 38 Customs, etc. Professional Examinations, as Medical, Legal, Preliminary, Scholarship, Certificate, College of Preceptors, University Locals, etc. Candidates rapidly prepared in Private Class or by Correspondence. Commercial Subjects, as Shorthand, Book-keeping, Précis, etc., also taught. Prospectus free from
J. KEEFE, 22, Great George Street, LIVERPOOL.

BORD'S PIANOS
ON SALE
WITH 25 PER CENT DISC^T FOR CASH,
OR 15^s PER MONTH ON THREE YEARS' HIRE SYSTEM.
SECOND HAND ON 3 YEARS' SYSTEM 10/6
PER MONTH. ILLUSTRATED LIST FREE OF
PIANOS EXCHANGED Chas. Stiles & Co
42 SOUTHAMPTON ROW, HOLBORN, LONDON W.C.

EPPS'S
GRATEFUL—COMFORTING.
COCOA

PENLEY'S PATENT PEN GUIDE.
Invaluable for Teachers.
Prevents the fingers from becoming cramped.
Cost of an ordinary penholder.
'Nothing could be better for giving the Child a right start than this Penholder.'—*School Board Chronicle.*
SAMPLE SENT ON RECEIPT OF 3 STAMPS.
SOLD BY ALL STATIONERS.
E. WOLFF & SON, MANUFACTURERS, LONDON.

MURBY'S IMPERIAL COPY BOOKS.
'EXCELLENT.' *Rapidly finding their way into all good Schools.* 'UNEXCELLED.'
17 NUMBERS, PRICE 2d. EACH.

1. Half Text.	5½. Large and Small.	9. Small Hand.
2. Half Text.	6. Small Hand.	10. Small Hand.
3. Half Text.	6½. Double Small.	11. Small Hand.
3½. Large and ½ Text.	7. Small Hand.	12. Small Hand.
4. Half Text.	7½. Three Hands.	20½. Ladies' Hand.
5. Small Text.	8. Small Hand.	

London: THOMAS MURBY, 3, Ludgate Circus Buildings, E.C.

OVER 430 SUCCESSES! 14 FIRST PLACES.
Day, Evening, and Correspondence Classes.
THE LONDON CIVIL SERVICE COLLEGE,
27, CHANCERY LANE, LONDON.
EIGHT YEARS OF UNPARALLELED SUCCESS. RESULTS UNEXCELLED.
DEPARTMENTS.—CIVIL SERVICE, LONDON MATRICULATION, QUEEN'S SCHOLARSHIP, CERTIFICATE, UNIVERSITY LOCALS, SPECIFIC SUBJECTS, etc., Messrs. SKERRY, F.S.Sc., SMITH, M.A., CROMB, M.A., BARBER, B.A. (Hons.), JOCELYN, LL.B. (Cambs.), and Co. (22 Tutors, Graduates of London, Cambridge, etc.).
Clerkships, Men (age 17-20, Salary £80-£250), 1st, 2nd, 3rd, 4th, 5th, 9th, 16th, 27th, 31st, 37th, 39th, etc.; Excise (19-22, Salary £95-£300), 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, etc.; Customs (19-25, Salary £55-£200), 1st, 3rd, 4th, 5th, 6th, 7th, 8th, etc.; Female Clerks (18-20, Salary £65-£80, etc.), 2nd, 5th, 12th, 17th, 37th, 47th, 54th, and 16 Places last Female Clerks (Feb., 1887); Boy Clerks (15-17, Salary £36, etc.), 3rd, 8th, 9th, etc.; Surveyors of Taxes (19-22, Salary £100-£400), 1st, 3rd, 4th, etc.; 1st Place (Feb.) Office of Works, Ireland.
Highest places at all centres throughout Great Britain and Ireland.
PRACTICAL GUIDE TO THE CIVIL SERVICE, post free, from Mr. Skerry, F.R.S.L., of H.M.C.S., 27, Chancery Lane, London, W.C.
ORDER THE
'Civil Service Competitor,'
1d. weekly, of all booksellers, or sent free for 1s. 8d. per quarter. Contains full details, with latest Examination Papers worked in full, original articles, books to read, etc. More information than in any similar publication.
Enquiry Office open daily 9 a.m. to 6 p.m.

GEORGE GILL & SONS,
RECENT PUBLICATIONS.
All Teachers should see the following before ordering new books.

THE 'WHITEHALL' LITERARY READERS.
The only Standard Readers; specially compiled to suit the latest requirements of the Code. They are not old reading books re-dressed, but are entirely new.

STANDARD I. ... ... 9d.	STANDARD III. ... ... 1s. 0d.
STANDARD II. ... ... 10d.	STANDARD IV. ... ... 1s. 3d.

STANDARD V. (Voyages and Travels; comprising scenes from the history of Exploration.) The most interesting reader published. ... 1s. 4d.
STANDARDS VI. & VII. (Extracts from the Works of Standard Authors.)... ... ... 1s. 6d.
Also Primers Part 1, 2, and 3; each 3d. Cloth.

THE 'ALBERT' GEOGRAPHICAL READERS.
The most interesting, the most readable, and the most beautiful Geographical Readers yet produced.

STANDARD I. ... ... 9d.	STANDARD IV. ... ... 1s. 0d.
STANDARD II. ... ... 9d.	STANDARD V. ... ... 1s. 4d.
STANDARD III. ... ... 1s. 0d.	STANDARD VI. ... ... 1s. 6d.

STANDARD VII. ... ... 1s. 6d.

THE 'WHITEHALL' DRAWING COPY BOOKS.
Specially prepared in accordance with the New Schedule. The following numbers are now ready:—

FREEHAND DRAWING.	MODEL DRAWING.
STANDARDS I. & II. ... No. 1. ... 2d.	STANDARD IV. ... ... No. 4. ... 2d.
STANDARD III. ... ... No. 2. ... 2d.	STANDARD V. ... ... No. 7. ... 2d.
STANDARD IV. ... ... No. 3. ... 2d.	GEOMETRY.
STANDARD V. ... ... No. 6. ... 2d.	STANDARD IV. ... ... No. 5. ... 2d.
	STANDARD V. ... ... No. 8. ... 2d.

GILL'S PRACTICAL GEOMETRY FOR THE STANDARDS.
These little Text Books contain all that is necessary for this subject. Standard IV., 1d.; Standards V. and VI., 2d. each.

THE WHITEHALL COPY BOOKS.
In Twelve numbers, two for each Standard. These Copy Books are the most practically useful in the market. Price 2d.

GEORGE GILL and SONS, LONDON.

BRITISH 14DE87